PERCUTANEOUS TRANSHEPATIC CHOLANGIOGRAPHY

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Introduction

Percutaneous transhepatic cholangiography is a radiological examination which is of particular value in cases of obstructive jaundice, because investigations of the biliary system using contrast media administered orally, such as Telepaque, Biloptin or Solu Biloptin, or intravenously such as Biligrafin are of no value in such cases; in particular, no shadow appears with Biligrafin when the serum bilirubin is greater than 4 mg./100 ml. and clinical jaundice is not associated with less than 2 mg./100 ml.

The investigation of a case of persistent obstructive jaundice, therefore, tends to be along clinical and biochemical lines (Sherlock, 1962). Plain radiography may show enlargement of liver, spleen or gall-bladder, stones or gas in the biliary system or calcification in the liver; barium studies may show varices, duodenal abnormalities such as ulceration, enlargement of the duodenal loop or diverticula, or even reflux up the bile-ducts. In the absence of such findings, and if the other investigations do not make the aetiology clear, it is common for laparotomy to be the next step in the hope that the obstruction may be either a remediable one, such as a stone or fibrosis of the duct, or one capable of being bypassed by cholecyst-enterostomy or choledoch-enterostomy if inoperable, such as a neoplasm or irreparable fibrosis; it is in this situation that percutaneous transhepatic cholangiography can be of value.

The first demonstration of its feasibility is usually attributed to Carter and Saypol (1952) in the United States, although in fact it had been reported fifteen years earlier by Huard and Do-Xuan-Hop (1937) in Indochina. In 1907, when searching for liver abscess, it had been observed that a dilated biliary system, due to parasitic obstruction by the trematode Clonorchis sinensis, could be entered easily by needle puncture of the liver. This was confirmed in a cadaver in 1933; the method was used in a case of common bile-duct stenosis in 1935 and of carcinoma of head of pancreas in 1937 to obtain, by injecting Lipiodol, a preoperative radiographic demonstration of the biliary tree.

Carter and Saypol, encountering difficulties with intraoperative cholangiography, particularly when the common bile-duct was difficult to find, demonstrated at operation that, in cases of obstructive jaundice with consequent distension of the biliary tree proximal to the obstruction, needle puncture of the liver was almost certain to produce communication with one or other dilated bile radicle. They then extended the procedure to a case of obstructive jaundice and needled the liver through the intact skin to show the biliary tree radiographically, using an aqueous contrast medium.
Following this, Nurick et al. (1953) performed the investigation on four patients, one of whom died of intraperitoneal haemorrhage and biliary peritonitis. This demonstrated the importance of preparation of the patient by checking the prothrombin time beforehand, giving vitamin K routinely—both were omitted in their fatal case—and also of being prepared to operate immediately afterwards if necessary.

Kidd (1956) reported six successful cases and formulated the following indications for the procedure:

To investigate biliary signs and symptoms after cholecystectomy; to diagnose carcinoma in the biliary system; to show calculi in the biliary system; to measure intrabiliary pressures in cases alleged to have spasm of the sphincter of Oddi; to differentiate obstructive from hepatocellular jaundice.

To these, Remolar et al. (1956) added further indications deduced from their series of thirty-four cases in the United States as follows:

Injection of antibiotics into the biliary tree; creation of external biliary fistula; elucidation of the state of the biliary tree in congenital biliary astasia.

Interest in the technique was maintained in the United States and Kaplan et al. (1961) reported forty cases.

Meanwhile, on the continent of Europe, needling of the biliary tree seemed to have proceeded apace. Leger et al. (1953) reported fourteen cases, Crismer (1953) nine cases, de la Fuente et al. (1954) four cases and Housset and Vantsis (1957) four cases. Kapandji (1956) devised a technique for puncturing the gall-bladder under fluoroscopic control after opacifying it by oral cholecystography and Royer et al. (1956) punctured the gall-bladder with the aid of "coelioscopy," but these two techniques did not apparently find favour in Europe or elsewhere.

All these workers used a long fine needle, usually 18 gauge and 6 or 9 in. long, connecting it to a syringe by flexible tubing. This allowed needle movement during respiration. Shaldon et al. (1962) at the Royal Free Hospital considered that there was a distinct hazard of liver trauma under these circumstances. They improved the technique by using a 6 in. 20 gauge needle sleeved with polythene tubing (PE 160), withdrawing the needle immediately after entry into the liver to leave the tubing in situ, and reported thirty cases. The technique has also been described in detail by Young (1962). It is not difficult, requires only conventional radiographic apparatus and is relatively free from danger provided it is planned as a preoperative measure. A somewhat similar technique has been reported by Arner et al. (1962) in a series of fifty-six cases.

Reported here are four cases investigated by this technique at The Queen Alexandra Military Hospital, Millbank.

**Technique**

Usually, the examination is requested by the surgeon who has decided that laparotomy is inevitable and has decided to operate at 2 p.m. Prothrombin time is checked and vitamin K given as part of the preoperative preparation. The patient comes to the X-ray Department at about 10 a.m., having been given suitable premedication as advised by the anaesthetist. Several pieces of polythene tubing (PE 160
or Allen and Hanbury No. 2) are prepared beforehand, one end flanged to fit the Seldinger tap adaptor and the other drawn out with artery forceps and cut off so as to fit neatly and snugly round the 6 in. 20 gauge needle just proximal to the tip.

The patient lies supine on the fluoroscopic X-ray table and the skin of the upper abdomen and right lower costal region is swabbed with antiseptic. The site of insertion is 2.5 cm. below and to the right of the xiphisternum, adjacent to the costal margin, and at this point skin, subcutaneous tissue, muscle and peritoneum are infiltrated with local anaesthetic. The skin is pierced with a fine-pointed scalpel and a track opened with fine Spencer Wells "Mosquito" forceps down to peritoneum. This is essential to prevent the end of the polythene catching and buckling. The needle, on which is threaded the polythene catheter and the cap of a Seldinger tap adaptor, is then applied to the track and the patient is asked to breathe in deeply and hold his breath. In one smooth movement needle and catheter are together inserted up to the hilt in a backward, upward and lateral direction through the track into the liver. The needle is immediately withdrawn and the patient allowed to breathe.

The Seldinger tap adaptor is then screwed home on to the prepared polythene, a further length of wider-bore polythene with appropriate adaptors connected to this and a syringe applied to the end. Gentle suction is applied; in cases of obstructive jaundice there is usually an immediate flow of bile, though it may be blood-stained. If no flow occurs the catheter is gently and slowly withdrawn until it does; if still no bile is obtained the catheter may be withdrawn completely and the insertion repeated with a fresh needle and catheter, but no more than four insertions may be made. Often after aspiration of 5-15 ml. or so the flow stops; a short wait will allow it to start again as the pressures readjust in the biliary tree. It is of course essential to have air-tight connectors.

Once communication with the biliary system is achieved a 20 ml. syringe loaded with an aqueous contrast medium such as 45 per cent Hypaque is connected, and the contrast medium slowly injected, under fluoroscopic control. A characteristic pattern of filling should be readily observed, but it takes a few minutes for the contrast medium to diffuse into all parts of the biliary tree; much of the bile is concentrated and viscous. In particular, where the obstruction is below the junction of cystic and common hepatic ducts, although the gall-bladder is usually enlarged it may take some time, say 15-20 minutes, before that organ is opacified. Films are taken on the screen in supine and both oblique positions, the most useful being the left anterior oblique, which throws the common bile-duct clear of the spine.

If no bile is obtained further insertions of the needle may be made, but the procedure should be abandoned if four insertions are unsuccessful; under these circumstances it is most unlikely that the obstruction is biliary but more likely hepatocellular in nature.

On conclusion of the procedure, the plastic tube and connector is secured to the skin (a combination of Nobecutane and adhesive tape is useful) and the patient returns to the ward to await operation. There the tubing is connected to a sterile underwater drain so that bile can drain out and not into the peritoneum. Biliary peritonitis is painful and unpleasant to the patient and can be dangerous; it is inevitable in the absence of drainage since bile under pressure in the biliary tree will force its way.
Through the puncture wound. It is for this reason that this investigation may be embarked upon only as a preoperative measure; and the operation should normally be carried out within four hours and most certainly within six hours.

It is important to make the catheter tip fit the needle closely, as in all catheter work of this nature. This is achieved by pulling out the end of the catheter with artery forceps, an art readily acquired with a little practice. Failure to achieve this introduces the risk of buckling or crumpling the catheter on attempting to introduce it.

**Discussion**

There is no doubt that percutaneous transhepatic cholangiography is a relatively simple technique requiring little in the way of apparatus which is not already available in most conventional departments. There is also no doubt that good films can be obtained which show the site of the obstructive lesion accurately and often give a clue to its nature. In general, a malignant obstruction produces a rounded end like a glove-finger, a fibrous stricture a tapering point—although an irregularly tapering point can also occur in obstruction due to malignant disease—and a stone two points with a proximal convexity between them. It carries, however, the hazard of biliary peritonitis due to leak from the liver puncture which produces much pain and discomfort and, if unrelieved, eventual death; for this reason it is again stressed that the procedure be carried out as a preoperative one and that the operation be delayed not more than four hours—six hours at the very most. It may thus be reasonably asked why the patient should be subjected to a slightly hazardous diagnostic procedure shortly before the laparatomy at which the diagnosis is to be made—in the course of which, if necessary, intraoperative cholangiography can be carried out if the surgeon required it.

The arguments in favour of preoperative percutaneous transhepatic cholangiography are as follows:

1. It can be performed under optimum radiographic conditions in the X-ray department. Portable X-ray work in operating theatres is apt to be disappointing in the absence of special equipment. Hence these preoperative films have a better chance of being of diagnostic value.

2. The delay until the operation allows time for careful study of the films, for a preoperative diagnosis and for a provisional preoperative plan. In Case 3 (Fig. 3) it was clear that the obstruction was above the cystic duct, so that the gall-bladder could not be used in the relief operation; in Case 4 (Fig. 4) it was at the junction of cystic and common hepatic ducts and again unlikely that the gall-bladder would be of use; whereas in Case 1 the gall-bladder and cystic duct were not involved, so that cholecyst-enterostomy was satisfactory for the relief of jaundice.

3. The film can be of value in assisting the surgeon in his exploration of the common bile-duct, in that he knows what to look for and where; in particular, where the obstruction is high up, it can show him whether or not the case will be operable.
4. Decompression of the biliary system, as observed by Housset and Vantsis (1957), allows the vascularity of the liver, previously interfered with by the biliary distension, to return to normal. This may be regarded as beneficial to the patient by improving the preoperative condition of his liver, though its exact value must remain speculative.

The four cases reported here illustrate four distinct sites of biliary obstruction: below, at and above the entry of the cystic duct (Cases 1, 4 and 3) and generalized widespread infiltration of the smaller tributaries of the biliary tree (Case 2). The latter was impossible to distinguish by this technique from a hepatocellular or cholestatic jaundice; it illustrates the importance of operating immediately after the procedure.

Most of the authors previously quoted have not regarded this procedure as essentially preoperative; failure to enter a dilated biliary radicle has been regarded as a contra-indication to operation, and in cases where operation has been clearly necessary it has been delayed up to ten days. Shaldon et al. (1962) are, however, firmly of the opinion that it is essential to operate within four to six hours if a dilated biliary tree is shown, and we have adopted this principle. It might well be argued that if adequate drainage of the biliary system is achieved, then there is no need for urgency. We do not accept this; biliary drainage was successfully arranged on only one occasion (Case 3). It is very easy to dislodge either the catheter or the needle while screening or subsequently, and suppurative cholangitis is readily acquired.

Shaldon et al. do not now advise laparotomy in cases where a dilated biliary system has not been shown. It may be that Case 2 described above is exceptional, but its findings would not seem to support that view.

The hazards of the procedure when it has not been regarded as a preoperative measure have been amply confirmed by reports in the literature. Nurick et al. (1953) lost one patient out of four from biliary peritonitis; Leger (1953) lost two out of fourteen, one from liver haemorrhage and the other from biliary peritonitis; Caroli (1955), when using the procedure to create an external biliary fistula, reported three cases of suppurative cholangitis. Edwards (1962) had one case of biliary peritonitis where operation was delayed for five days, and Arner et al. (1962) had one patient die within twenty-four hours of operation, on the seventh day. The latter also draws attention to the danger of forming a bile-blood fistula.

The site of puncture is occasionally in dispute. Shaldon and colleagues and most English and American workers have favoured the anterior approach as described above, but Huard and Do-Xuan-Hop (1937), Housset and Vantsis (1957) and Edwards (1962) prefer a lateral approach, either in the anterior or lateral axillary line, 8th or 9th intercostal space respectively. We prefer the anterior route because we are less likely to find pleura, and the site of puncture is more readily accessible to inspection at operation; from the point of view of the investigation itself the site is probably immaterial.

Attempts to enter the undilated biliary tree, as made by several continental authors, require repeated needling of the liver, particularly of its hilum, or of the gall-bladder. The repeated needling of this region, as Housset and Vantsis point out, would appear hazardous to most radiologists. It is considered that of the indications listed by Kidd (1956), Remolar et al. (1956) and Kaplan et al. (1961) only those concerned with a
dilated biliary tree are applicable, which means, in effect, first, elucidation of the cause of persistent obstructive jaundice, and second, temporary drainage of the biliary system pending operation in such a case. By restricting the procedure to these simple indications, it is considered that this procedure can be added to the general radiologist's armamentarium as a useful and reasonably simple investigation in cases of obstructive jaundice prior to surgery.

**Summary**

The development of the technique of percutaneous transhepatic cholangiography, using a catheter sleeved on a needle, is described. Its value and indications for use in the preoperative diagnosis of obstructive jaundice are discussed and four illustrative cases are reported.

**Case Reports**

**Case 1**

A 47-year-old warrant officer was admitted to hospital on 10th May, 1962, with one month's history of vague epigastric discomfort with heartburn and a sensation of fulness in the upper abdomen; he had been jaundiced for three weeks.

Percutaneous transhepatic cholangiography was performed on 1st June, 1962, and showed a distended biliary system with a rounded obstruction to the lower end of the common bile-duct, which was displaced forwards from the spine and resembled a glove-finger (Fig. 1(a)). The gall-bladder was demonstrable partly opacified on a later film and was greatly enlarged (Fig. 1(b)). The appearances suggested a malignant tumour obstructing the lower end of the common bile-duct and, at laparotomy in the afternoon, a vast, hard, fixed mass occupying the head of the pancreas was found. Cholecystojejunostomy was performed.

The abdomen contained an appreciable amount of free bile and blood (approximately half a pint) owing to the fact that the catheter came out of the liver towards the end of the manipulation of the patient on the fluoroscopic table.

**Case 2**

A 34-year-old warrant officer complained on 26th June, 1962, of constipation for three weeks and of a poor appetite for two months. He had lost half a stone in weight in the last two or three months and had been jaundiced for two days. The urine contained excess bilirubin but no urobilinogen. Other liver function tests were normal. The only other positive finding was occult blood in the stools. He improved a little but the jaundice deepened and he was transferred to The Queen Alexandra Military Hospital on 8th July.

A barium meal showed marked dilation of the duodenum from the second part onwards, and of the proximal jejunum, but was otherwise normal (Fig. 2(a)). This is sometimes associated with malignancy in this region, especially of pancreas, and it was expected that obstruction to the common bile-duct by a growth of this type would be found.

Percutaneous transhepatic cholangiography was performed on 17th July, 1962, but three insertions of the needle failed to find bile and the procedure was abandoned with the report: "This may be due to failure of the technique, but it may also be due to the jaundice not being due to extra hepatic obstruction but due to liver disease."

At laparotomy that afternoon the gall-bladder and common bile duct were found to be collapsed. A mass round the head of the pancreas extended up behind the lesser sac and down alongside the aorta. There were enlarged nodes in the porta hepatis and one large mass in the great omentum. The collapsed common bile-duct was opened and cannulated: a cholangiogram was performed (Fig. 2(b)) which demonstrated only one major tributary of the right hepatic duct. A plastic tube connecting common bile-duct to duodenum was left in situ and the abdomen closed.
The patient's condition slowly deteriorated and he died on 16th February, 1963.

The histology of the biopsy and post-mortem specimens showed the lesion to be a carcinoma of the bile-ducts which was infiltrating widely along the biliary tree. This, together with the glands in the porta hepatis, explains the presence of obstructive jaundice without a distended biliary system, and also the fact that, even on direct cannulation of the common bile-duct, only one tributary of the right hepatic duct could be shown.

Case 3

A 59-year-old senior officer had been well, apart from amebic dysentery thirty years ago, periodic vague dyspepsia and occasional mild constipation; three months before his admission he started to have lower abdominal discomfort and distension, mostly on the right side, with an acute exacerbation after six weeks.

He was admitted to The Queen Alexandra Military Hospital on 21st December, 1962, and barium meal and follow-through on 1st January, 1963, showed some diverticula in the ascending colon. He was discharged with diagnosis of diverticulitis on 3rd January, 1963, on Probanthine and Milpar, but was readmitted on 11th January, 1963, unimproved. He now had jaundice with pale stools and dark urine; liver function tests indicated obstructive jaundice without liver damage. The jaundice deepened, and on 22nd January percutaneous transhepatic cholangiography was performed as a preoperative measure. Three punctures were required before a free flow of bile was obtained; 15 ml. of viscous straw-coloured bile was aspirated and replaced by 30 ml. of 45 per cent Hypaque. The biliary system was dilated and the common hepatic duct terminated in a pointed, almost "hollow ground" end above its junction with the cystic duct. Neither cystic duct nor gall bladder was shown (Fig. 3). This appearance has been said to be more in favour of fibrotic stricture, and was reported accordingly. Samples of bile were passed to the laboratory for cytology. The patient was returned to the ward and a sterile under-water drain set up.

At operation in the afternoon the peritoneum, omentum and liver were found to contain many secondary deposits. The pancreas had a nodule in its head, and gall-bladder and common bile-duct were involved in a mass of neoplasm, which obstructed the common hepatic duct. The gall-bladder was removed, the common hepatic duct anastomosed to a loop of jejunum, and the abdomen closed with drainage. Histology of excised nodules showed a carcinoma of the gall-bladder. It was a relatively fibrous growth and this may explain the appearance of the stricture.

Case 4

A 29-year-old officer was referred to the Medical Out-patient Department at the end of November, 1962, with a ten-day history of severe epigastric pain, relieved by food and alkalies. A barium meal on 15th January, 1963, showed a deformed duodenal cap, but nothing else abnormal. Shortly after this he complained of nausea, anorexia and abdominal discomfort and he was by 21st January obviously jaundiced. He was initially diagnosed as infective hepatitis, but the jaundice deepened, with increasing serum bilirubin, raised alkaline phosphatase and normal thymol turbidity. He was transferred to The Queen Alexandra Military Hospital on 8th March, where serum bilirubin was 46 mg./100 ml. The diagnosis of ampullary carcinoma was considered. A further barium meal on 12th and 15th March showed delayed gastric emptying with a greatly dilated duodenal loop, again suggestive of malignancy in this region.

Percutaneous transhepatic cholangiography demonstrated a distended biliary system with obstruction at the junction of the cystic and common bile-ducts and a dilated gall-bladder (Fig. 4). The appearances suggested malignant infiltration. Unfortunately the catheter became dislodged from the liver, and biliary drainage while awaiting operation was not possible.

At operation there was a lot of free bile in the abdomen. A dilated gall-bladder and cystic duct and common hepatic duct were observed and the junction of the cystic duct and common bile-duct was involved in a cicatricial process which also involved the stomach near the pylorus. There was a hard mass in the pancreas attached to and puckering the duodenum. The gall-bladder was removed and choledoch-enterostomy and posterior gastro-enterostomy performed.

He improved post-operatively but was readmitted some months later and died. Post mortem showed a carcinoma of the pancreas.
REFERENCES

Young, W. B. (1962). Personal Communication.