The Operative Cholangiogram:

Its Interpretation, Accuracy and Value in Association with Cholecystectomy

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The value and errors of one method of operative cholangiography were assessed prospectively with the aim of reducing further the incidence of unnecessary explorations of the common bile duct and the occurrence of residual stones. Operative cholangiograms were obtained using a cystic duct cannula in 174 cases, the technical failure rate being 2%. All cases were followed up using intravenous cholangiography where necessary. Of 129 judged normal by the operator, 2 were found to have common bile duct stones—false negative rate 1%. Of 45 judged abnormal by the operator, 10 had negative explorations—false positive rate 6%. Anomalies were discovered in 12% of patients. It is concluded that meticulous technique and accurate interpretation are essential for the best results. The high incidence of anatomical variations present is of interest and this alone emphasises the necessity of carrying out the investigation and the need of experienced interpretation.

RESIDUAL STONES and bile duct injury are two of the most important factors which influence the morbidity and mortality in elective cholecystectomy. The place of operative cholangiography in detecting stones in the common bile duct and in defining the anatomy of the individual case is well established;[5,10] other aids such as bile duct manometry and choledochoscopy have evolved with the same purpose, but are as yet of unproven efficacy.[7] The full value of operative cholangiography depends upon meticulous technique and accurate interpretation.

The value and the errors of one method of operative cholangiography was assessed in a prospective study with the aim of reducing further the incidence of unnecessary explorations and residual stones.

Materials and Methods

In a consecutive series of 207 patients undergoing cholecystectomy, operative cholangiography was attempted in 176 cases (85%). The clinical and other features of this series of patients have been described elsewhere.[2] In the remaining 31 patients, operative cholangiography was omitted for several reasons (Table 1). One-hundred forty two (69%) of cases had cholecystectomy alone, 65 patients (31%) had duct exploration as well.

The technique used to obtain operative cholangiograms was that described by Fraser and McNair,[4] using the cystic duct cannula of Aldrete and Judd,[1] in 172 cases and by needle puncture of the duct in 5 cases. Two films were usually obtained, using 5 ml and 9 ml Conray 280 60% respectively with the patient tilted 10° head down. A third film was retained in the cassette tunnel for the purpose of obtaining a post-exploratory t-tube cholangiogram should it be necessary. If the bile duct was explored, peroperative postexploratory t-tube cholangiography was usually attempted, and subsequently postoperative t-tube cholangiograms were performed in every case. Each patient was followed up carefully using intravenous cholangiography to demonstrate the ducts, where necessary. All cholangiograms were reviewed by two observers, the films being interpreted using the criteria suggested by Le Quesne.[8] In all cases except 6, i.e. 201 out of 207 (97%), adequate visualization of the biliary duct system was obtained by operative cholangiography, t-tube cholangiography or intravenous cholangiography at late followup. The 6 exceptions, not having had operative cholangiography, declined to have intravenous cholangiography on review, since they were asymptomatic.

Results

The gross results of treatment in this series were good, i.e. there were no deaths and few complications. Of the 174

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TABLE 1. *Operative Cholangiogram Omitted (31)*

Palpable common bile duct stones	17	17 (explored)
Radiographic equipment failed	2	14 (not explored)
Non availability of X-Ray equipment	3	
Electively omitted on clinical grounds	9	

TABLE 2. *Abnormal Operative Cholangiograms Not Explored (9)*

No visualisation of common hepatic duct	4 (one had residual calculus)
Overlying gas shadows or air bubbles obscured X-ray	3
Stricture lower end of common bile duct	1
No contrast into duodenum	1

TABLE 3. *Abnormal Operative Cholangiograms Explored Without Success (8)*

Surgeon recorded stone pushed into duodenum	4
Dilated duct—negative findings	2
No medium into duodenum prior to exploration	1
Artefact due to crossing of right hepatic artery	1

FIG. 1. Artifact due to right hepatic artery crossing common hepatic duct.

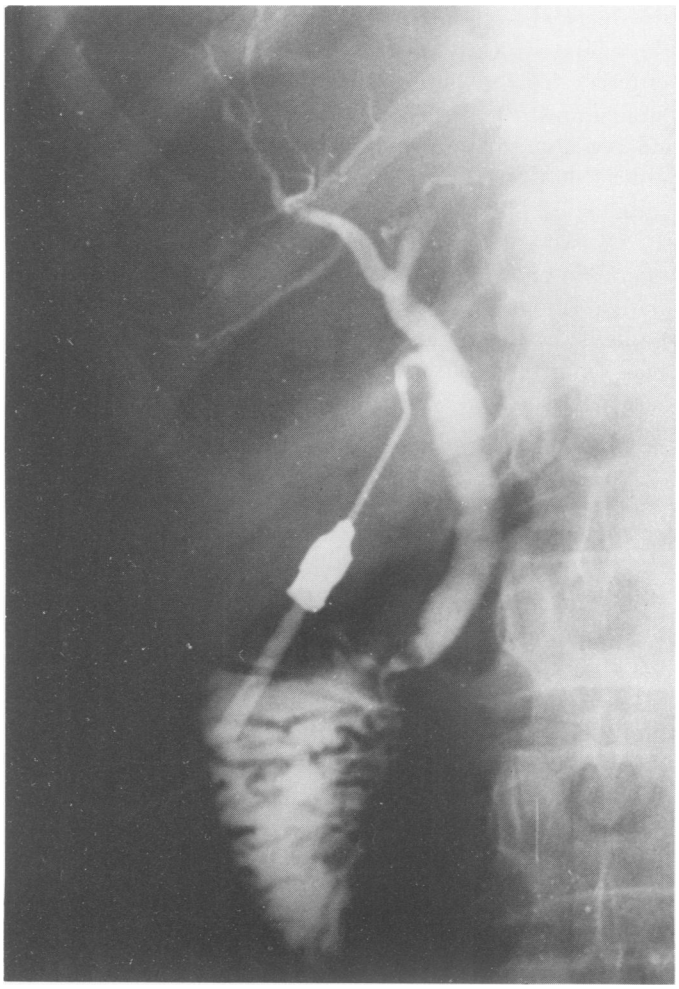

FIG. 2. Stone at lower end common bile duct which was not recovered but pushed through into duodenum.

successful operative cholangiograms, 129 were judged to be normal at the time of operation. In 2 of these, stones in the common bile duct were subsequently found: in one case the surgeon, at operation, palpated a stone despite an apparently normal X-ray and in the other patient, jaundice occurred 9 months after operation, a stone was identified on intravenous cholangiography and removed at a second operation. The false negative rate, therefore, was 1%.

Of the 45 operative cholangiograms judged abnormal at the time of operation, stones were recovered at operation in 35, and exploration was negative in 10. In the latter 10 patients, no stones were shown on postoperative t-tube cholangiography or on followup. There were, therefore, 10 false positives in 174 cholangiograms, 6%. Of the 35 patients who underwent exploration and in whom stones were recovered, 3 were found to have residual calculi on the postoperative t-tube cholangiogram and 2 subsequently required re-exploration. In only 1 of these was a stone recovered.

The above results show the accuracy of operative cholangiography as judged by the success of exploration of

the ducts when indicated by the surgeon's interpretation of the operative X-rays at the time of operation. Using strict criteria[8] in the interpretation of the operative cholangiograms, 9 further cholangiograms might be considered abnormal and these had not been explored but in only 1 has a residual calculus been demonstrated. The radiological abnormalities in this group are shown in Table 2. In two of the patients undergoing exploration, the operative cholangiograms were subsequently judged to be normal and in fact exploration had been negative. In 8 patients the cholangiogram was still considered to be abnormal on review but exploration had been negative; the reasons associated with these apparent errors are listed in Table 3 and illustrated in Figs. 1–3.

Anomalies

Anomalies in duct architecture were noted in 21 (12%) of the 174 operative cholangiograms carried out (Table 4). The commonest anomaly encountered was drainage of the common bile duct into the third part of the duodenum in 10 (6%) cases (Fig. 4). Others encountered include an accessory right hepatic duct in 3 cases, and the cystic duct draining into the right hepatic duct in 2 cases (Fig. 5). These anomalies are of importance in avoiding injury to the duct system. There was a diverticulum of the lower end of the common bile duct in two cases. Both of these were associated with residual stones (Fig. 6) one requiring subsequent exploration and in the other the stones passing spontaneously after the t-tube had been clamped for 4 weeks.

TABLE 4. *Twenty-one Anomalies (12%)*

Bifid cystic duct	1
Long cystic duct	1
Cystic duct → RHD	2
Accessory RHD	3
CBD → 1st part of duodenum	1
CBD → 3rd part of duodenum	10 (6%)
CBD lower end anomaly	1
CBD diverticulum	1
Ampullary diverticulum	1

Complications

In 3 patients complications arose out of the use of operative cholangiography. In 1, leakage of the bile from a wound persisted for 7 days and may have been the result of needle cholangiography, and in another the cystic duct was torn on cannulation and subsequent exploration of the duct and t-tube drainage had to be carried out. In a third, the common bile duct was pierced by an over-sharpened cannula, and again exploration and t-tube drainage was embarked on to avoid biliary leakage following operation. In

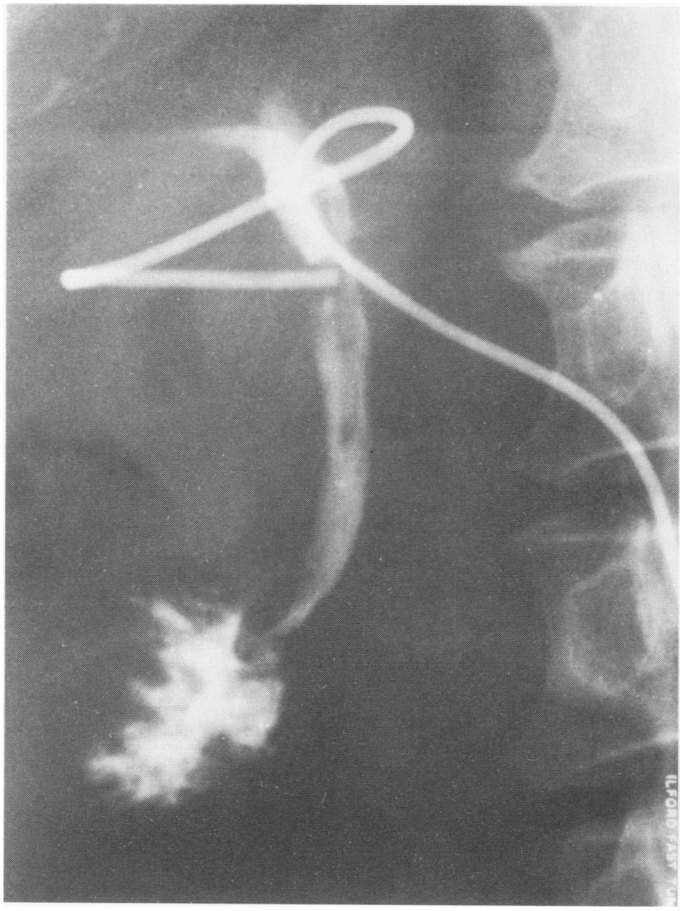

FIG. 3. Same patient as FIG. 2—postoperative T-tube cholangiogram.

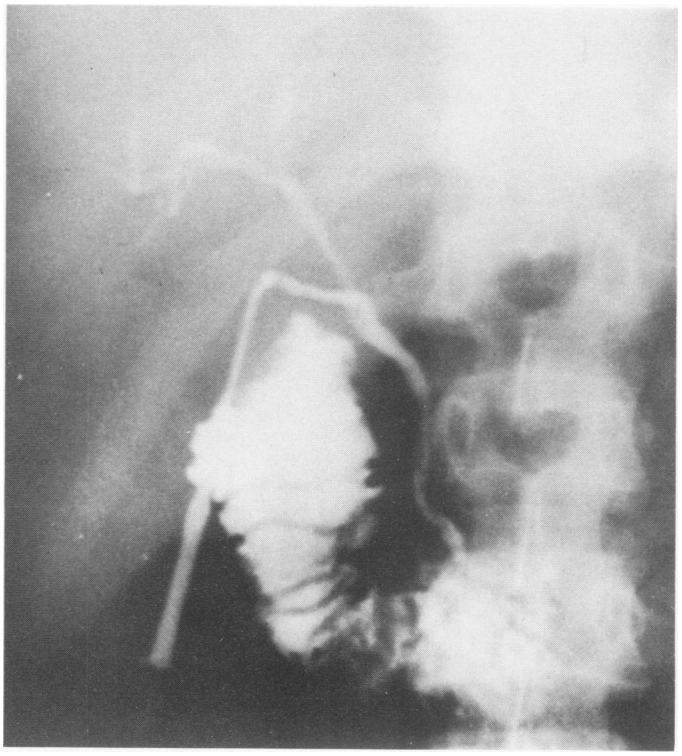

FIG. 4. Common bile duct draining into 3rd part of duodenum.

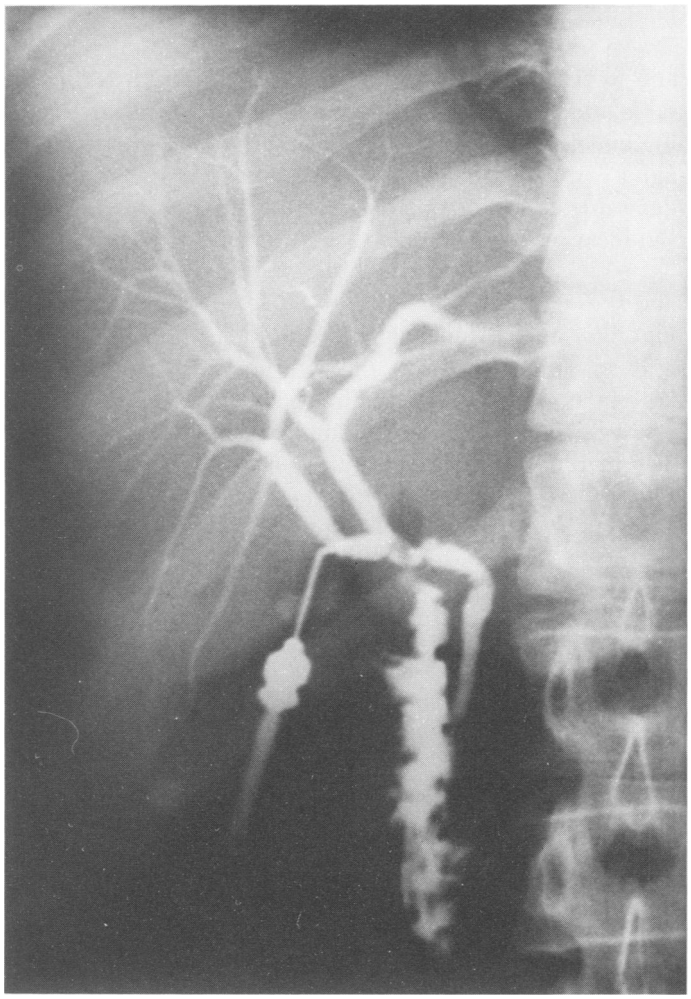

FIG. 5. Cystic duct draining into right hepatic duct.

none of these 3 cases was the complication serious and their convalescence was uncomplicated. There was one case encountered in this series of the syndrome first described by Walters and Bollman[11] and known in Edinburgh as the "Waltman Walters" Syndrome. This was not related to the use of operative cholangiography but was due to removal of the t-tube on the tenth day postoperatively and there was a subsequent collection of bile which required reoperation.

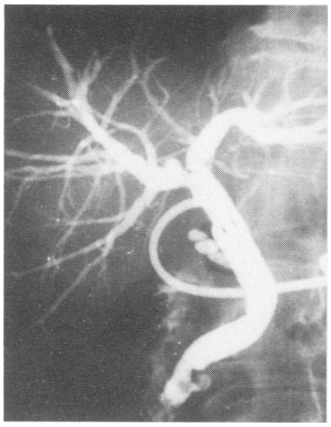

FIG. 6. Calculi in common bile duct diverticulum.

Other Features

In 34 (20%) of operative cholangiograms, contrast medium entered the pancreatic duct (Fig. 7). This was not associated with any symptoms of back pain, evidence of duct stones or postoperative pancreatitis. Entry of radio-opaque dye into the pancreatic duct was also seen in 24% of the postoperative t-tube cholangiograms but was rare in the postexploratory peroperative cholangiogram.

Discussion

Of 176 cholangiograms, 172 were attempted using the cystic duct cannula and this was successful in 169 cases. Three failures by this technique consisted of one failure to cannulate a very narrow cystic duct and the other two cases referred to above (torn cystic duct, cannula piercing wall). Thus the technique was successful in 98% of cases.

Technical failure, false positive and false negative rates compare favourably with those of bile manometry and choledochoscopy as alternative methods of detecting stones in the common bile duct.[3,9] Our own experience with

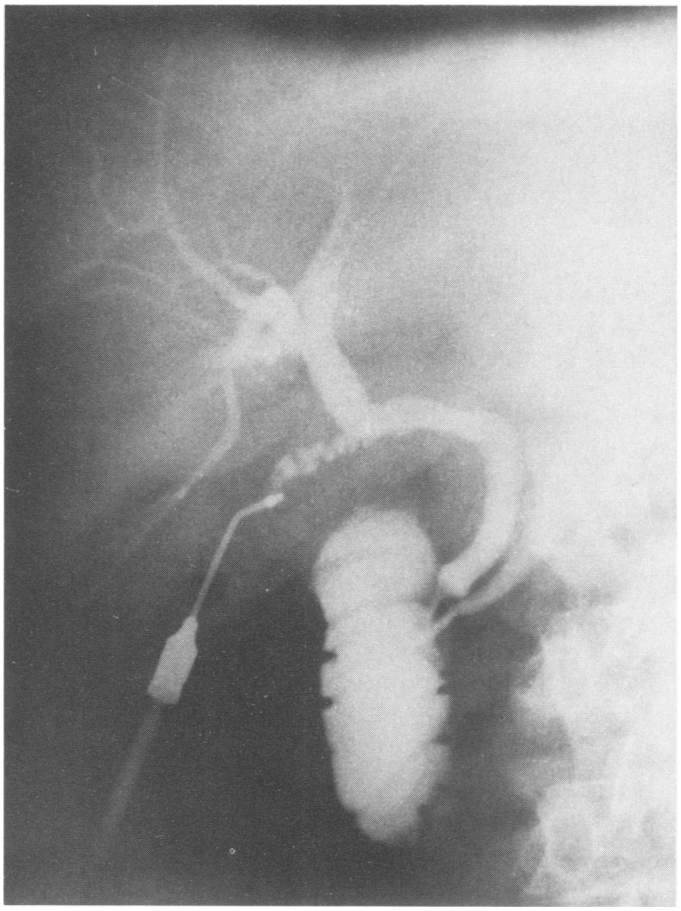

FIG. 7. Reflux of contrast medium into pancreatic duct—operative cholangiogram.

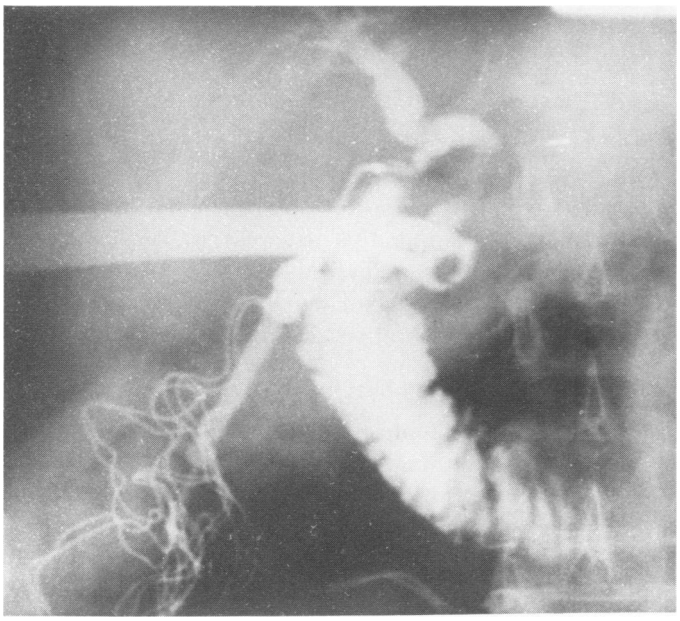

FIG. 8. Towel clip obscures the common bile duct.

choledochoscopy early in the series gave poor results. It was attempted in 15 cases, reasonable visualisation of the common bile duct and right and left hepatic ducts occurred in only 6, and in 2 of these, residual stones were found after operation despite apparent clearance. In reviewing the factors associated with negative exploration, failures of interpretation and technique are both present. The commonest cause is a stone being pushed into the duodenum, and the surgeon is generally aware of this. Failure to remove packs and instruments may obscure the lower end of the common bile duct (Fig. 8) or may prevent dye entering the duodenum. If the surgeon is unaware of possible artefacts caused by crossing of the right hepatic artery, exploration may be carried out unnecessarily. In the interpretation of the cholangiogram, failure to visualise the common hepatic duct occurred in 4 cases. None of these was explored but at late followup intravenous cholangiography, 1 has been shown to have a residual stone. For this reason it is important to visualise the hepatic ducts if necessary by tilting the table or occluding the lower end of the duct while dye is being injected for a third X-ray film. We would not, therefore, agree with Lawson and Gunn[6] and others that failure to demonstrate the hepatic ducts adequately is of little significance.

In 12% of our cases duct anomalies were demonstrated and the realization of this allowed for better and safer exploration of the ducts when required.

It is concluded from this prospective study that the criteria of Le Quesne[8] ought to be followed if the best results of operative cholangiography are to be obtained. The method used in this series proved simple, reliable and safe.

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