

DIGESTIVE DISEASES

Endoscopic Retrograde Cholangiopancreatography (ERCP)

Experience with 100 Cases

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Endoscopic visualization of the papilla of Vater was achieved in 98 of our first 100 attempts. Cannulation was successful in 87% of cases, achieving pancreatography alone in 29, cholangiography alone in 27, and both in 31. The relevant duct was adequately visualized in 72.5% of patients with biliary tract disease and in 72% of those with pancreatic disease. Complications were acceptably few. The procedure has proven valuable in difficult cases of obstructive jaundice and biliary type pain syndromes without jaundice. Many questions remain, however, as to its value in the diagnosis and evaluation of pancreatic disease.

In 1969 Nakayama (1) reported visualization of the ampulla of Vater via the lateral-viewing fiberoendoscope. Since then, groups in Japan (2-6), Great Britain (7-10), France (11), Hungary (12), Germany (13), and the United States (14) have reported success rates of 74-96% in cannulating the ampulla and obtaining retrograde cholangiopancreatography. A recent comprehensive paper by Cotton (10) reviews the world literature concerning over 2500 cases of cannulation and discusses in detail such important aspects as technique, preparation, success rates, complications, and clinical relevance. We will present here the results of our first 100 attempts at cannulation in a variety of clinical situations. Our groups consist of patients with obstructive jaundice, biliary type pain without jaundice, relapsing pancreatitis, and suspected pancreatic carcinoma.

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MATERIALS AND METHODS

The Olympus JF fiberoendoscope was the only instrument employed. It has lateral-viewing optics, a four-directional deflecting tip, and a working length of 125 cm. The instrument was passed with the patient in the left lateral position on a padded x-ray table. Premedication consisted of diazepam (Valium) intravenously (usual dose 10 mg) and a pharyngeal spray containing 2% tetracaine (Cetacaine). Occasionally, additional diazepam was needed during the procedure. The fiberoendoscope was passed through the pylorus. Immediately upon entry into the second portion of the duodenum hypotonicity was achieved by the administration of propantheline bromide (Probanthine) 30 mg i.m. and glucagon 1 mg i.v. Simethicon (Mylicon) 0.6 ml in 10 ml of water was then instilled via the 1.5-mm-diameter teflon cannula for its antifoaming effect. The patient was then turned to the prone position and search for the major papilla begun. Fluoroscopy was helpful at this point to assure that the fiberoendoscope was in the mid-descending duodenum. When the papilla and the area of its orifice were identified, an *en face* view was achieved by rotating the patient and/or manipulating the deflecting tip on the instrument.

The teflon cannula was then filled with 80% sodium iothalamate (Angio-Conray) or 66% meglumine diatrizoate/10% sodium diatrizoate (Renografin-76) and passed through the biopsy channel. When the tip of the instrument was within 2 cm of the papillary orifice (*en face*), cannulation was attempted. Upon entry into the papillary orifice the contrast agent was injected slowly and carefully

Table 1. Results of 100 Attempts at Cannulation

Result	Cases
Papilla seen	98
Cannulation successful	87 (40 of first 50) 47 of second 50)
Ductal system(s)	
visualized	87
Pancreatic alone	29
Biliary alone	27
Biliary + pancreatic	31

through the cannula under constant fluoroscopic control. The normal pancreatic duct is filled with 2-5 ml of con-

trast agent, the intact biliary tract with 15-30 ml, and the postcholecystectomy biliary tract with 8-10 ml. Radiographs were taken of the opacified duct(s).

If the desired duct was not initially opacified, selective cannulation was attempted by a series of maneuvers, including advancing, retracting, or deflecting the cannula while injecting contrast agent. If this was unsuccessful, injection was made while rotating the patient with the cannula still in place; or the cannula was withdrawn, and the patient recannulated while in a different position (i.e., left lateral, supine).

RESULTS

ERCP was attempted 100 times in 97 patients (Table 1). The major papilla was iden-

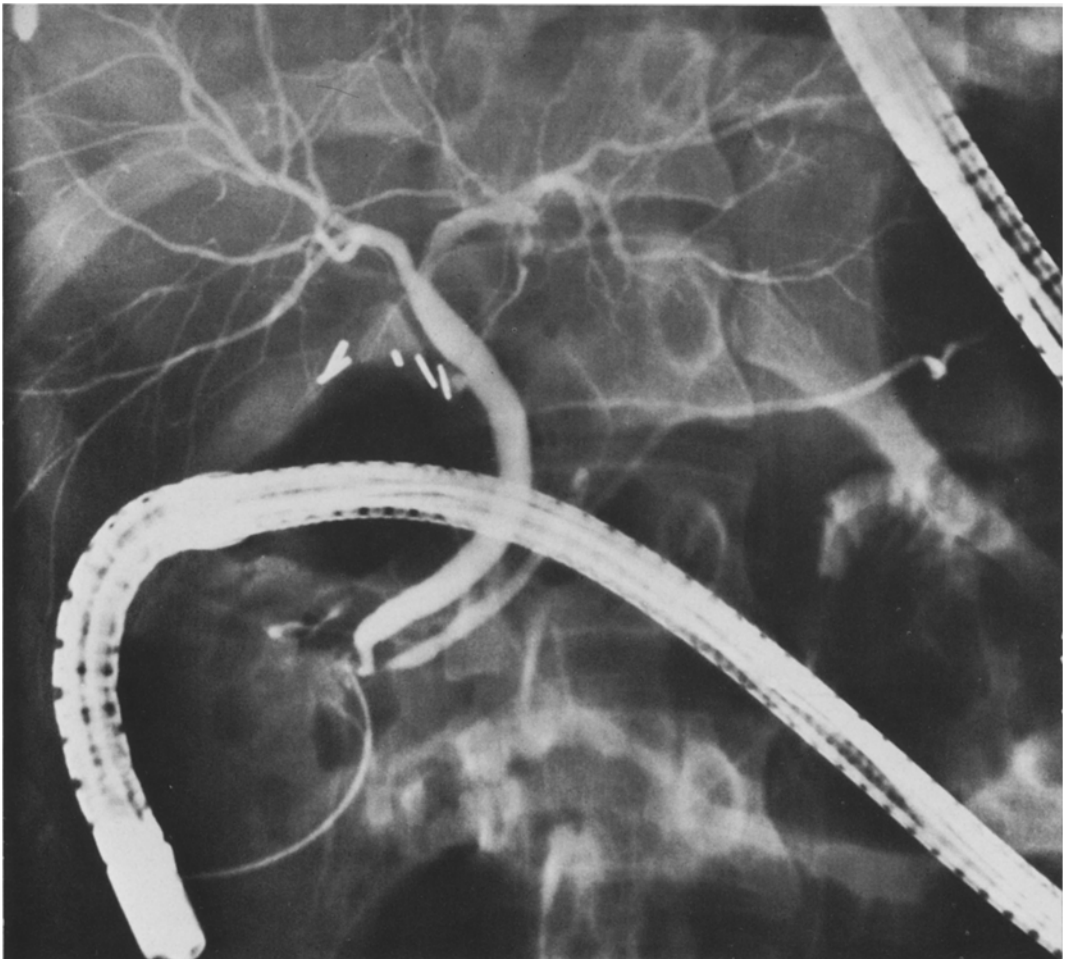


Fig 1. Normal pancreatic and biliary ducts, postcholecystectomy.

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Table 2. Complications of Retrograde Cholangiopancreatography

	Patients	Complications
Cholangiography alone	27	0
Pancreatography	60	18
		<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> ↓ Asymptomatic hyperamylasemia (15) </div> <div style="text-align: center;"> ↘ Acute pancreatitis (2) </div> <div style="text-align: center;"> ↗ Infected pseudocyst (1) </div> </div>
Serum amylase (Somogyi units)		
	200-415	9
	415-800	3
	800-1000	3

tified 98 times; the only 2 failures were in patients with duodenal diverticula in whom the papilla presumably arose within the diverticulum. In 2 other patients with duodenal diverticula, the papilla arose within the diverticulum in one, and on its outer rim in the other. Both were cannulated with difficulty. In 5 patients, 2 separate orifices were visualized on or adjacent to the major papilla. In all 5, both orifices were successfully cannulated. In 5 cases where a sphincteroplasty existed the gaping orifice was easily seen and cannulated, but adequate ductal opacification was difficult since the contrast agent tended to reflux into the duodenum.

Of the first 50 attempts at cannulation, 40 (80%) were successful. As our endoscopists became more skilled, particularly in identifying the papilla and its orifice, in positioning the instrument for a stable *en face* view, and in manipulating the catheter into the small opening, the success rate increased. Thus, cannulation was accomplished in 47 of the second 50 attempts (94%), for a total of 87% of the first 100 attempts. Following cannulation an attempt was made in all instances to fill both ductal systems.

The pancreatic duct alone was opacified in 29 cases, the common bile duct alone in 27, and both the common bile duct and the pancreatic duct in 31 (Figure 1). The relevant duct was visualized in 33 of the 46 patients with suspected

pancreatic disease (72%) and in 37 patients of the 51 with suspected disorders of the biliary tree (72.5%). There were no significant side effects of either the premedication or the agents employed to achieve duodenal hypotonicity. Of the 60 patients in whom pancreatography was obtained, 15 (25%) were noted to have an elevated serum amylase on the morning following the procedure (16-24 hours). Of these, 9 ranged from 200 to 400; 3 from 400 to 800, and 3 from 840 to 1050 Somogyi units. These elevations were transient, lasting less than 48 hours in all cases, and were asymptomatic. In addition, 2 of the 60 patients (3.5%) developed marked hyperamylasemia (> 1000 units) and abdominal pain. Both of these mild episodes of pancreatitis subsided within 24 hours with nasogastric suction. Both cases occurred early in the series, and were associated with inadvertent acinar filling. In another case, spiking fever developed after contrast agent filled a pancreatic pseudocyst; at surgery, an infected pseudocyst was drained. There were no complications following transduodenal cholangiography alone, even in cases where contrast was injected above high-grade obstruction (Table 2).

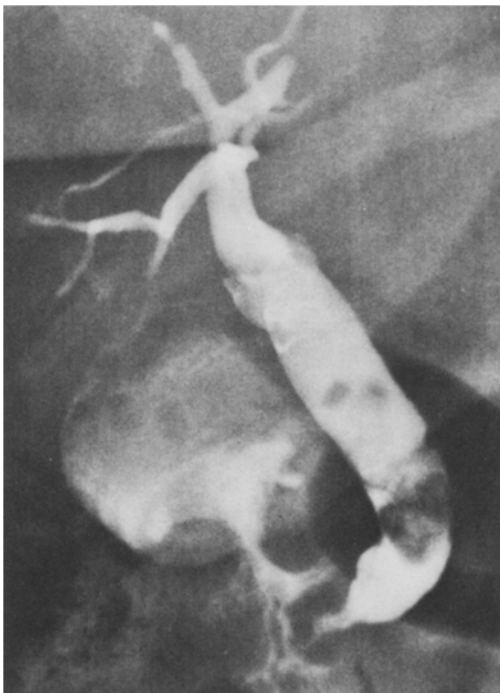
Group I—Obstructive Jaundice (Table 3, Figures 2, 3, 4)

Thirty-four patients with obstructive jaundice of unknown etiology were studied, including 23 males and 11 females, with an age range

Table 3. Obstructive Jaundice (34 patients)

Diagnostic ERCP studies		Nondiagnostic studies	
Choledocholithiasis	6	Normal pancreatogram only	5
Carcinoma, head of pancreas	4	Inadequate biliary tract opacification	2
Chronic pancreatitis and common duct stricture	2	Failure to cannulate	2
Common hepatic duct tumor	2		
Stricture, common bile duct (p.o.)	1		
1° sclerosing cholangitis	1		
Hepatoma with extrahepatic obstruction	1		
Cholelithiasis, normal common duct	4		
Normal biliary tract	4		
Total	25 (73.5%)		9 (26.5%)

of 24–89 years. There were 32 cannulations during 36 attempts in these 34 patients. In 25 of 34 patients (73%) significant diagnostic information was achieved. In 17, extrahepatic obstruction was documented, and in 8 it was ruled out. Surgery was performed in 13 of the 17 ob-

**Fig 2.** Choledocholithiasis

structed patients, and in each the ERCP diagnosis was confirmed. In one of the remaining 4 cases autopsy confirmed the ERCP diagnosis of carcinoma of the common hepatic duct. Two cases with suspected chronic pancreatitis obstructing the distal common bile duct were followed on medical management with slow subsidence of jaundice, and in a case of hepatoma with obstruction of the common bile duct and both intrahepatic ducts, surgery was not thought feasible.

After demonstrating a patient extrahepatic biliary tract in 8 cases, liver biopsy was performed in all, yielding various diagnoses, including lymphoma (2), drug-induced cholestasis (2), primary biliary cirrhosis (1), cholangitis and hepatic congestion (1), and cholangitis (2). Two of the patients with cholangitis had cholelithiasis on ERCP, and were thought to have passed a stone.

Group II—Suspected Biliary Tract Disease (Table 4)

Seventeen patients with suspected biliary tract disease were studied, including 11 females and 6 males (ages 16–74). Ten had previously undergone cholecystectomy. All had had recurrent episodes of biliary type pain, some with fever, elevated alkaline phosphatase, and jaundice. None were jaundiced at the time of this

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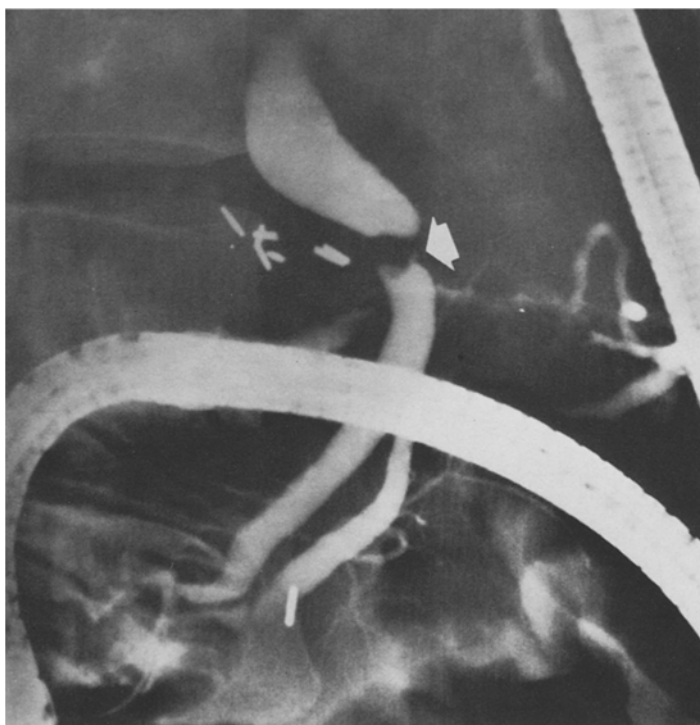


Fig 3. Common duct stricture secondary to postsurgical granuloma (arrow).

workup. Oral cholecystography and/or intravenous cholangiography had been performed in all cases and had been either nonvisualizing or nondiagnostic. Because of the recurrent nature

of their symptoms, exploratory laparotomy was being seriously considered in all these patients.

Cannulation was achieved in 15 of these 17 patients. In 12 of the 17 (71%) the biliary tract

Table 4. Suspected Biliary Tract Disease (17 patients)

Diagnostic ERCP studies		Nondiagnostic studies	
Choledocholithiasis	1	Normal pancreatogram only	2
Stricture, common bile duct	1	Inadequate biliary tract opacification	2
Calculus, cystic duct stump	1	Failure to cannulate	1
Stricture, right hepatic duct	1		
Ampullary stenosis; pancreatitis*	1		
Stricture, left hepatic duct†	1		
Normal biliary tract	6		
Total	12 (71%)		5 (29%)

* At surgery, # 1 Bakes dilator could not be passed; sphincteroplasty performed.

† Operative cholangiogram, after dilating stricture, showed intrahepatic cholelithiasis.

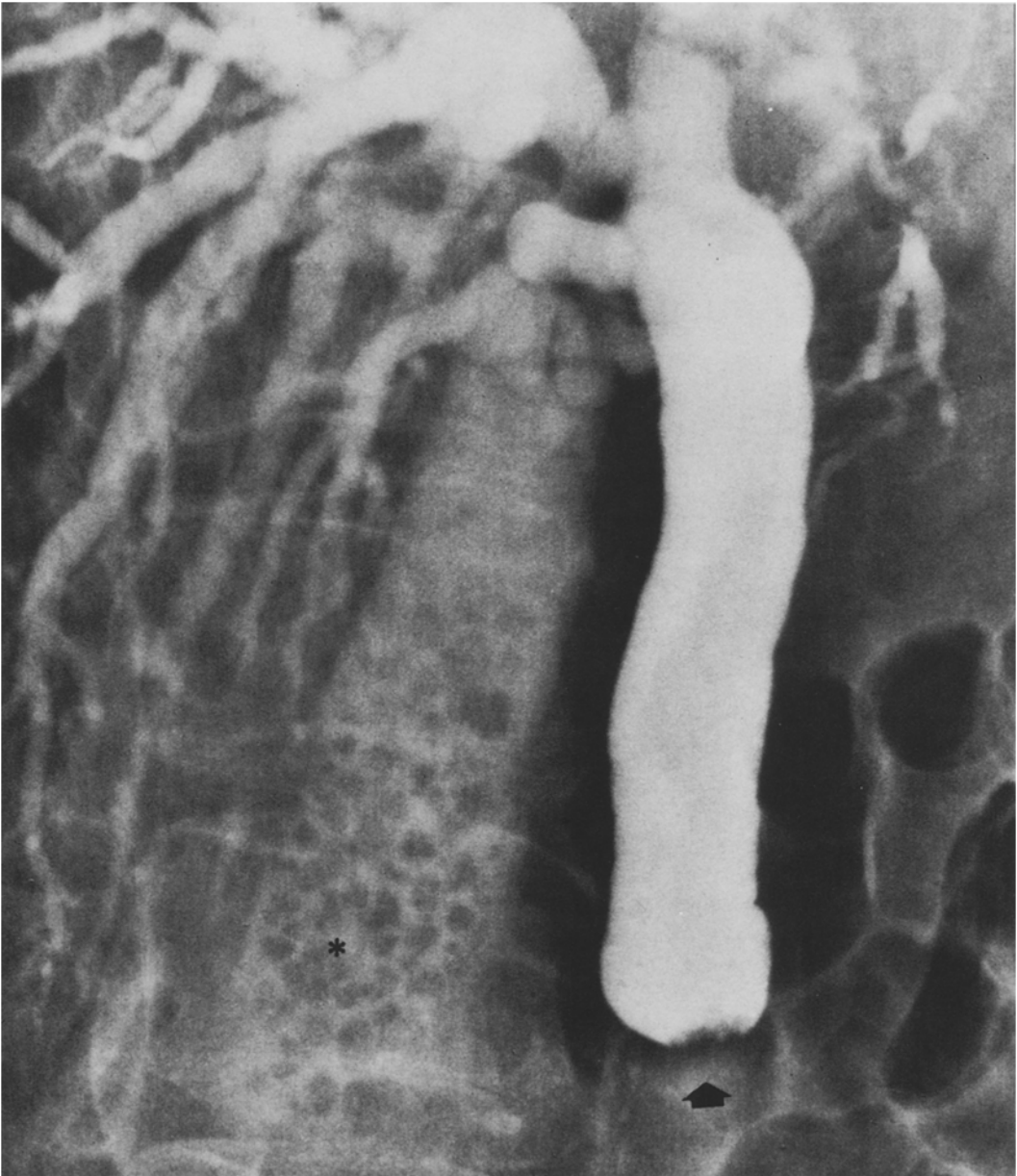


Fig 4. Multiple calculi in gallbladder (**asterisk**) and obstructing the common bile duct (**arrow**).

was well visualized, 6 showing a normal biliary tract while the remaining 6 showed definite biliary tract pathology, in 4 instances related to prior biliary tract surgery. In the 6 patients

with normal biliary tracts, surgery was prevented, and all have done well with reassurance and conservative medical management after a follow-up of 4–16 months.

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Table 5. Relapsing Pancreatitis (29 patients)

Pancreatogram (21)		Cholangiogram (14)	
Normal	10	Normal	11
Minimal pancreatitis	5	Cholelithiasis	1
Marked pancreatitis	4	Cholelithiasis + choledocholithiasis	1
Minimal pancreatitis + pseudocyst	1	Common bile duct stricture	1
Minimal pancreatitis + ampullary stenosis	1		

Group III—Relapsing Pancreatitis (Tables 5 and 6, Figure 5)

There were 30 cannulation attempts in the 29 patients in this group, which included 22 males and 7 females (age range 21–80 years). Twenty-one of the 29 were chronic alcoholics. All patients studied had had at least two prior documented attacks of pancreatitis. In 13 of the 29, pancreatic insufficiency was suggested by either pancreatic calcifications, steatorrhea, or glucose intolerance. Of these patients, 4 had all three of these findings, 6 had two, and 3 had one. None had hypercalcemia or type I or V hyperlipoproteinemia. In general, ERCP was not performed within 2 weeks of the last attack of pancreatitis.

Endoscopic pancreatography was achieved in 21 of 29 patients (72%). The pancreatic ductal system appeared normal in 10 patients. The criteria for chronic pancreatitis on ERCP have been thoroughly discussed by Kasugai et al (4), and we employed that system of evaluation. Minimal pancreatitis, consisting of beading and increased tortuosity of the duct of Wirsung, occurred in 5 patients. Marked pancreatitis was seen in 4, including 2 with calculi and 2 with marked ductal stenosis. All 4 of these patients had marked ductal obstruction and dilatation. In one additional case, ampullary stenosis was seen, and in another a pseudocyst was opacified in the tail of the pancreas.

Of the 14 cholangiograms achieved in these patients, 11 were within normal limits, one had cholelithiasis, one cholelithiasis and choledocholithiasis, and a third had a common bile duct stricture.

The patients with pancreatic insufficiency had more frequent and more severe ductal abnormalities than the ones without it (Table 6).

Group IV—Suspected Pancreatic Carcinoma (Figure 6)

There were 17 patients in this group, which consisted of 12 males and 5 females (ages 30–

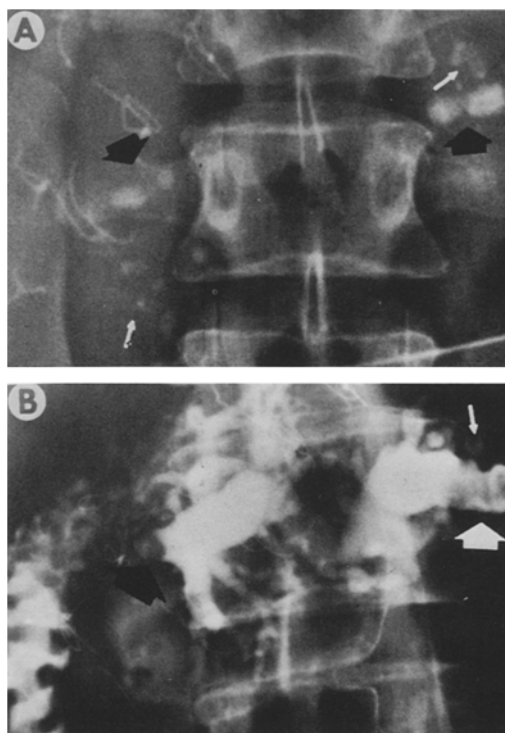


Fig 5. A. Multiple calculi on plain abdomen radiographs (see arrows). **B.** Pancreatogram showing calculi in dilated ducts (white arrows). Orifice obstructed by calculus (black arrow).

Table 6. Comparison of Functional Status to ERCP

	Patients	Pancreatogram	Normal	Minimal	Marked
No pancreatic insufficiency	16	12	8	4*	0
Pancreatic insufficiency	13	9	2	3	4†

* 1 had ampullary stenosis; 1 had pseudocyst in tail.

† 2 had calculi in major duct; 2 had stenosis of major duct.

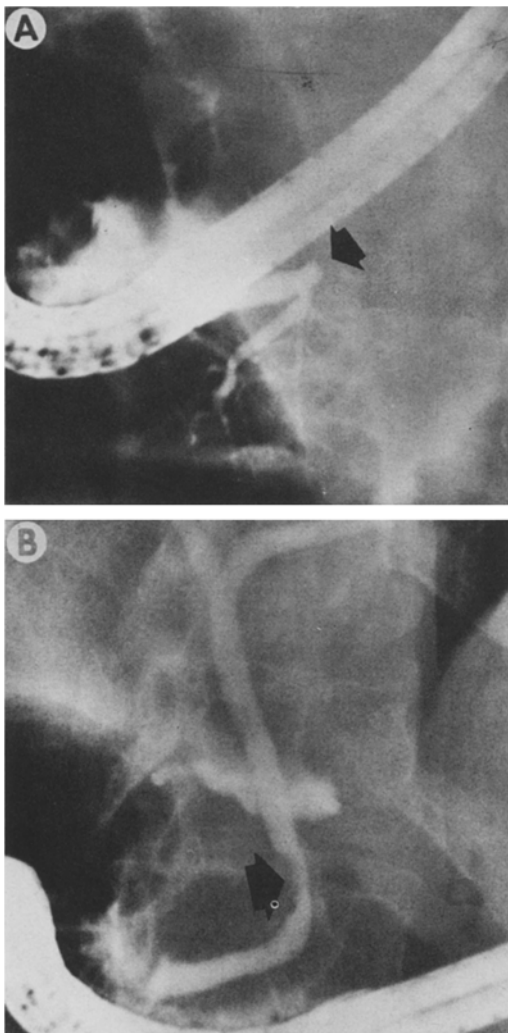


Fig 6. Cancer of the pancreas. **A.** complete obstruction of the pancreatic duct (**arrow**). **B.** Localized nodular involvement of one side of the common bile duct (**arrow**).

68). Cannulation was accomplished in 14 of 17 patients (82%), and the duct of Wirsung was adequately visualized in 12 (71%). Nine of 12 were normal, while 3 patients had complete obstruction of the major duct 3–4 cm from its orifice. Two of these subsequently had carcinoma of the head of the pancreas proven at laparotomy. Both cases had been studied by visceral angiography, with the diagnosis being suggested in one instance. The remaining patient refused surgery, became asymptomatic, and remains well 7 months after cannulation. Likewise, in this period of follow-up (6–18 months) none of the patients with normal ductal systems has developed clinical evidence of pancreatic carcinoma.

DISCUSSION

This study is another in the growing number reporting successful experience with ERCP as a diagnostic modality in biliary and pancreatic disease (2–14). Indeed, there were no fewer than eleven abstracts on this subject submitted to the Digestive Disease Week program in New York, May 1973, including six different groups in the United States.

Morrissey (15) and Ingelfinger (16) have advocated caution in assessing this procedure, and have questioned whether the clinical benefits of ERCP justify the cost of the instrument, training time involved, and the availability of a gastroenterologist, radiologist, and technician during the 1–2 hours often necessary for the procedure. Both Cotton and Beales (17) and Zimmon (18) in reply to Morrissey's editorial felt that he overstated the difficulties and costs

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Table 7. Comparison of Cholangiographic Techniques

	Intravenous cholangiography	Percutaneous cholangiography	Transjugular cholangiography	Transduodenal cholangiography
Difficulty	1+	2+	4+	4+
Degree of obstruction	Low (serum bilirubin < 3 mg/100 ml)	High only	High only	High; low; none
Ducts visualized	Common bile duct	Common bile duct	Common bile duct	Common bile duct and/or pancreatic duct
Contraindication	Sensitivity to contrast	Same as for liver bx	Cholangitis, coagulopathy	Acute pancreatitis, Au antigen positivity*
Complications	Anaphylaxis	Bile peritonitis, hemorrhage	Sepsis, hemorrhage	Pancreatitis, sepsis

* A relative contraindication reflecting problems in instrument sterilization.

involved, and that these problems were far outweighed by the advantages offered by ERCP in the diagnosis of biliary tract and pancreatic diseases. Unfortunately, since neither this nor any of the preceding papers on ERCP has done a cost-to-benefit ratio study, we cannot presently answer these questions.

A growing body of experience with ERCP, however, indicates that in many clinical situations the procedure has unique advantages over other available methods of studying the biliary tree (Table 7). With respect to obstructive jaundice, the biliary tract can be opacified despite poor liver function or marked hyperbilirubinemia, an obvious advantage over intravenous cholangiography. Neither the peritoneum nor the liver is punctured, eliminating the risks of bile peritonitis or hemorrhage, as in transhepatic percutaneous cholangiography (20, 21). The mortality for the transhepatic percutaneous procedure is approximately 0.25% (21). Percutaneous transjugular cholangiography (20, 22, 23) carries with it the risk of bacteremia and hemorrhage into the peritoneal cavity or biliary tree, and Weiner and Hanafee (22) reported 1 death from sepsis in 56 cases. The coagulation status must be adequate for the performance of either transhepatic or transjugular studies, but ERCP may be per-

formed despite a depressed prothrombin time. With ERCP there is the threat of bacteremia or pancreatitis, although it occurs in under 5% of cases in the literature. These complications are usually easily managed, and there is only one reported mortality in over 2500 reported ERCP studies (0.04%). A present limitation to ERCP is that biliary tract visualization is attainable only 70-80% of the time, whether the ducts are dilated or nondilated. This is in contrast to the percutaneous transhepatic and transjugular routes, both of which are successful in about 90% of cases with obstructed ducts but rarely visualize the nonobstructed biliary tree. We presently perform ERCP early in the workup of selected cases with obstructive jaundice. Two of our cases were diagnosed by this technique within 12 hours of admission.

In patients with biliary tract symptoms, without jaundice, a real dilemma arises when the oral or intravenous cholangiogram fails to visualize or is nondiagnostic. Here the lack of high-grade obstruction makes it difficult to visualize the biliary tree by either the percutaneous transhepatic or percutaneous transjugular approach. Laparotomy with operative cholangiography would be the only alternative to ERCP in this group of patients. ERCP saved a needless laparotomy in 6 patients in this group, while di-

recting the surgeon to specific biliary tract lesions in 6 others. The fact that all 6 lesions were different (Table 3) emphasizes the need for a preoperative assessment of the biliary tract so that the correct surgical approach can be planned.

The 29 patients with relapsing pancreatitis were studied with ERCP to evaluate preoperatively the pancreatic duct, possible biliary tract etiology, and suspected pseudocysts. Cotton (10) has demonstrated significant pancreatic ductal abnormalities in 23 of 28 patients with relapsing pancreatitis, and Gregg (24) has shown biliary tract abnormalities in 7 of 37 cases. In this series 11 of 21 pancreatograms and 3 of 14 cholangiograms in patients with relapsing pancreatitis were abnormal. Although this group is too limited for any firm conclusions, the group with pancreatic insufficiency had a greater percentage (78%) of ductal abnormalities than the group without insufficiency (33%). However, the fact that 2 of 9 (22%) of insufficiency patients had normal pancreatograms suggests that ERCP should not be thought of as a sensitive screening test for chronic pancreatitis. Rather, ERCP should be utilized to document the presence and location of ductal obstruction. Operative pancreatography was introduced by Doubilet et al in 1955 (25) and advocated by Trapnell (26) in 1967 and Howard and Short (27) in 1969. Several authors have discussed the multiple operative procedures available for chronic relapsing pancreatitis (28, 29, 30), and have stressed the logic in tailoring each operation to the particular patient's ductal anatomy. Preoperative ductal evaluation can presently be performed only by ERCP, and clearly offers an advantage, since the decision to perform pancreatic surgery may now be made, and the procedure to be employed may now be decided upon, before laparotomy.

Pancreatography in the presence of a pseudocyst deserves some comment. In one patient in this series a spiking fever developed after ERCP filling of a pseudocyst. The fever persisted de-

spite antibiotics, and 5 days later a large abscess within a pseudocyst was drained surgically, and the patient recovered. This complication, plus a recent report of fatal necrotizing pancreatitis after ERCP opacification of a pseudocyst (31), suggests caution in studying these patients. Presently celiac angiography (32, 33) and abdominal echography (34, 35) are our procedures of choice for the demonstration of a suspected pseudocyst. Should a pseudocyst be demonstrated in the course of ERCP, early surgical drainage may be necessary.

Of 12 pancreatograms in suspected carcinoma of the pancreas, 9 had normal ducts, and none of these (follow-up of 5-16 months) has subsequently developed clinical evidence of carcinoma. Three patients had complete ductal obstruction in the head of the pancreas. Two of these underwent a laparotomy, and both had biopsy-proven carcinoma. In one of these patients all other studies had been negative, including pancreatic angiography. The third patient refused surgery, became asymptomatic, and has been followed for 8 months. He may represent a false positive for carcinoma of the pancreas. Ogoshi et al (6) reported three pancreatographic patterns in pancreatic carcinoma, including the stenosed, obstructed, and stepped-slender type. It is of interest that both patients in his series (2 of 21) with resectable carcinoma were of the stenosed type. In this series, including the jaundiced patients, there were 6 cases of carcinoma of the pancreas, all with the obstructed type of duct and all extensive and unresectable.

In conclusion, it would appear from this experience and the experience at other centers that ERCP can make a major contribution to the diagnosis of obstructive jaundice and difficult biliary tract pain syndromes. Many questions remain, however, regarding the role of ERCP in the evaluation of pancreatic disease, including the following:

1. Can ERCP significantly aid in determining the etiology of relapsing pancreatitis?
2. To what extent will preoperative pan-

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creatography be helpful in individualizing surgery in relapsing or chronic pancreatitis?

3. What are the relative advantages of pancreatography compared with celiac angiography in the diagnosis of pancreatic carcinoma?
4. In interpreting the pancreatogram what is the incidence of false positives and false negatives for both pancreatitis and pancreatic carcinoma?
5. Can the pancreatographic patterns predict resectability of pancreatic carcinoma?

The answers to these and other questions will require a continuing accumulation of experience with this technique in patients with pancreatic disease.

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