

ANNALS OF SURGERY

VOL. 128

OCTOBER, 1948

No. 4



RECURRENT ACUTE PANCREATITIS: OBSERVATIONS ON ETIOLOGY AND SURGICAL TREATMENT * †

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THE WIDE USE OF SIMPLE LABORATORY PROCEDURES for the determination of serum amylase has revealed several facts regarding pancreatitis.

1. It is a common disease and varies in intensity from mild attacks to a fulminating catastrophe. Fortunately the latter event is a small proportion of the total cases.

2. Recurrence is common and may be anticipated. With repeated attacks there may be progressive destruction of functioning pancreatic tissue with pathologic changes in the gland and deficiencies in external and internal secretions.¹ On the other hand, in some patients after many years of recurrent attacks no measurable or visible changes occur in the gland.

3. Pancreatitis is frequently associated with biliary tract disease. Many disorders heretofore termed post-cholecystectomy syndrome, biliary dyskinesia etc. are actually recurrent attacks of pancreatitis.²

Previous factual knowledge has been available for many years, since Opie³ in 901 described the reflux mechanism. This is dependent on an anatomic variation in the entrance of the main pancreatic duct to the duodenum which creates a common biliary-pancreatic passageway, thus permitting bile to flow into the pancreas. The immediate bile diverting mechanism in Opie's case was a stone lodged in the ampulla of Vater. Archibald,⁴ in 1919, showed that a similar bile diverting mechanism could be brought about by spasm of the sphincter of Oddi.

The effectiveness of surgical management of the disease has not kept pace with the knowledge of what must be the mode of production in at least

* Aided by a grant from the National Institute of Health, United States Public Health Service, Grant # RG 807.

† Read before the American Surgical Association, Quebec, Canada, May 27, 1948.

a large number of cases. Decompression of the biliary tract by drainage to prevent reflux is effective only so long as the drain remains. Sympathectomy to interrupt pain sensation is not a direct attack on the disease. Section of the esophageal vagus to paralyze the sphincter of Oddi might be effective but it deprives the gastro-intestinal tract of that innervation. Local nerve interruption⁵ seems rational but is technically difficult and its effect is temporary,

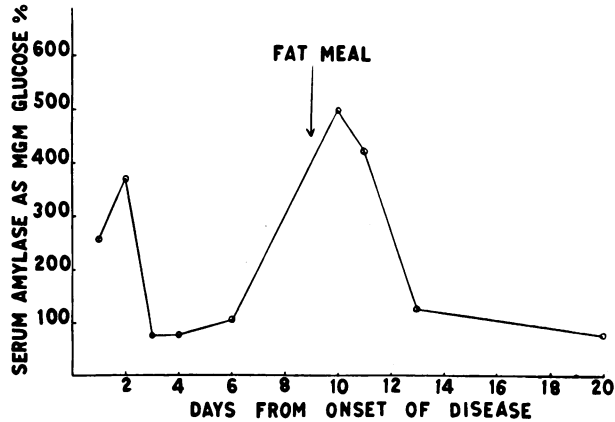


FIG. 1.—(Case 13) Serum amylase determinations demonstrate recovery from an attack of acute pancreatitis and recurrence following administration of a fat meal.

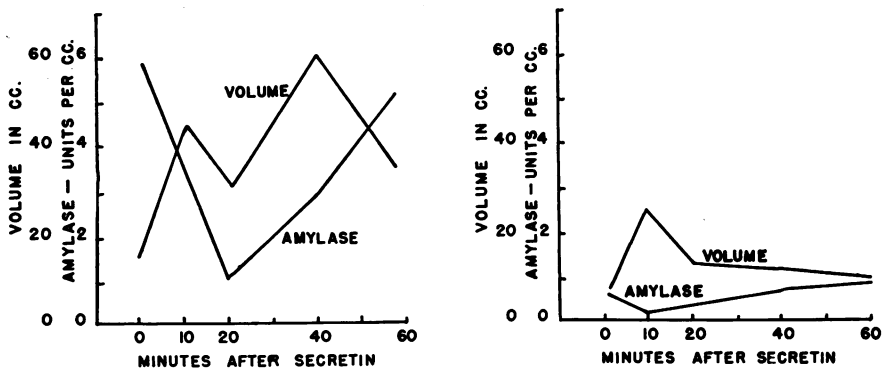


FIG. 2.—Quantitative evaluations of pancreatic functions.

apparently due to regeneration of the nerves.⁶ Archibald first directly approached the problem by cutting the sphincter of Oddi in a human patient with recurrent pancreatitis.⁷ He had noted the uniformly good results which followed removal of a stone impacted in the ampulla, when, perforce, the sphincter had to be cut.

Studies on patients with proven recurrent pancreatitis substantiate Archibald's contention that when a common passageway exists spasm of the

sphincter will produce the disease and sectioning of the sphincter will relieve the disease. The study here reported was conducted on the basis of the following concepts:

A. That serum amylase determinations during an attack will establish the diagnosis of acute pancreatitis (Fig. 1). In the absence of a rise in serum amylase the diagnosis is not necessarily excluded. With long standing disease and fibrosis or calcification of the gland there may be no rise in serum amylase or the level may be low.

B. That the intravenous administration of an assayed quantity of secretin will produce a flow of pancreatic juice which, when collected through a

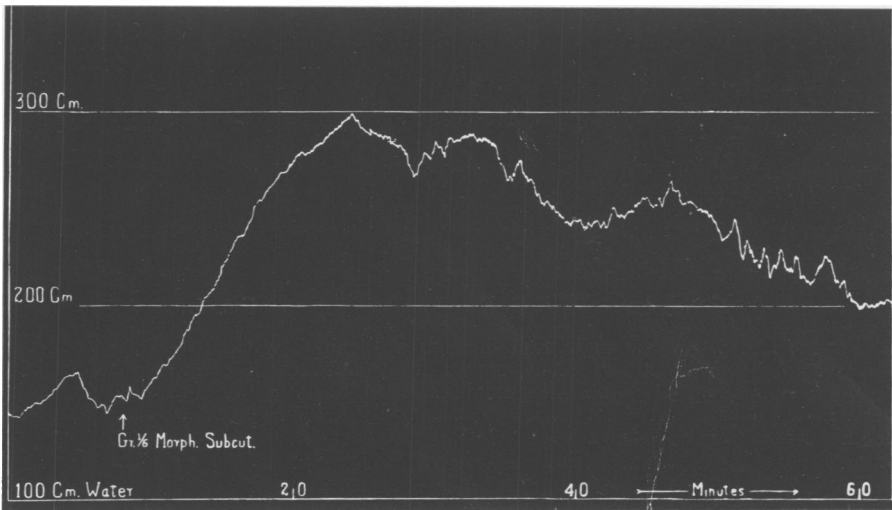


FIG. 3.—Effect of morphine on the sphincter of Oddi. Kymographic tracing of the resistance of the human sphincter of Oddi as measured through a T tube in the common duct, shows that the normal resistance of the sphincter (150 mm. of water) rises to 300 mm. and gradually subsides to 200 mm. in 1 hour. The effect persists for 4 hours.

duodenal tube, can be measured for total amount, amylase content, and bicarbonate content. The measurements are quantitative evaluations of pancreatic functions (Fig. 2).

C. That the administration of morphine will produce spasm of the duodenal wall and resistance to pancreatic and biliary flow, as demonstrated by kymographic pressure tracings recorded through a T tube in the common bile duct (Fig. 3). Cholangiograms done through a T tube in the common bile duct also demonstrate the contraction of the duodenal wall and resistance to the flow of bile (Fig. 4 & 5).

D. The N/10 Hydrochloric acid applied to the papilla of Vater will produce spasm of the sphincter of Oddi, as demonstrated by kymographic pressure tracings taken through a T tube in the common bile duct (Fig. 6), and in cholangiograms done through a T tube (Fig. 7). This same spasm can be



FIGS. 4 and 5.—A cholangiogram through a T tube 2 weeks after transduodenal sphincterotomy for ampullary stone, shows ready entrance of contrast medium into the duodenum (Fig. 4). Following administration of morphine (Fig. 5) the compression of the intramural portion of the common bile duct by the increased tonus of the duodenal wall is demonstrated.

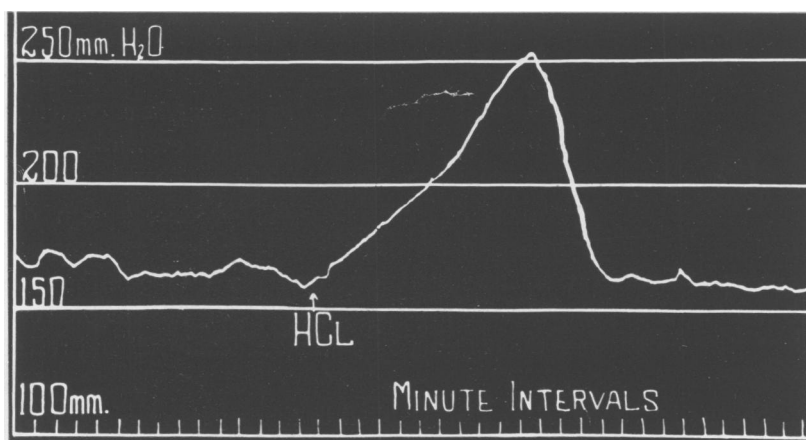


FIG. 6.—Kymographic tracing of the resistance of the sphincter as measured through a T tube in the common duct. The resistance of flow rises from 150 to 250 mm. of water. The effect lasts about 10 minutes.

produced by sudden, painful distension of the common duct through a T tube (Fig. 8 & 9).

E. That operative cholangiograms done by injecting contrast medium through a needle into the cystic or common duct at the same time that N/10

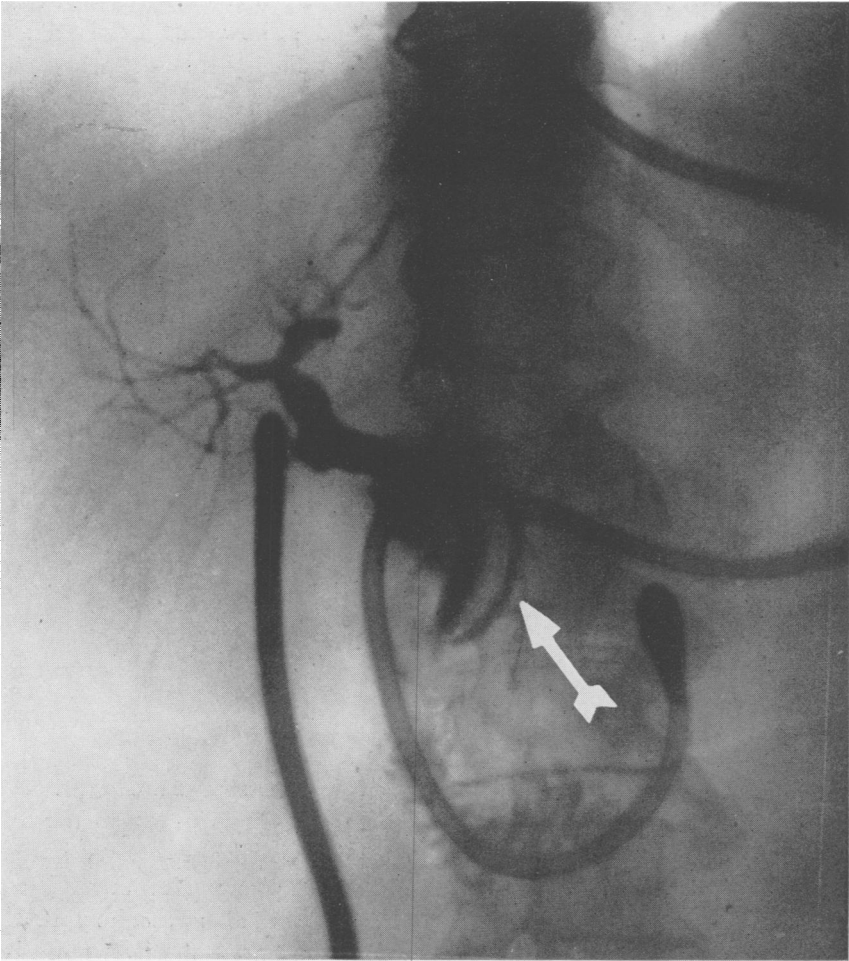


FIG. 7.—Cholangiogram performed through a cystic duct tube 2 weeks after cholecystectomy (sphincter intact). Hydrochloric acid applied directly to the papilla through a duodenal tube causes spasm and reflux of contrast medium into the pancreatic duct (arrow).

hydrochloric acid is applied to the papilla can demonstrate the passageway (Fig. 10).

F. That, after section of the sphincter muscle, the hydrochloric acid effect on the papilla is abolished (Fig. 11). The sphincter can no longer become spastic and biliary reflux under pressure is prevented. The morphine effect on the duodenal wall persists. Thus, reflux of the duodenal contents into the

biliary tract is prevented. In one patient with calcified pancreas and distortion of the duodenum and papilla, the muscle was incompletely sectioned as shown by kymographic tracings after hydrochloric acid application to the papilla (Fig. 12 & 13). This patient's pain was relieved, however, presumably because the resistance created by the remaining muscle fibers was insufficient to force bile into the pancreatic duct.

In patients whose pancreatic fibrosis is marked and pancreatic function diminished, sectioning of the sphincter relieves pain but does not restore normal digestion until the pancreas has regenerated which may take several weeks to months. (Fig. 14).

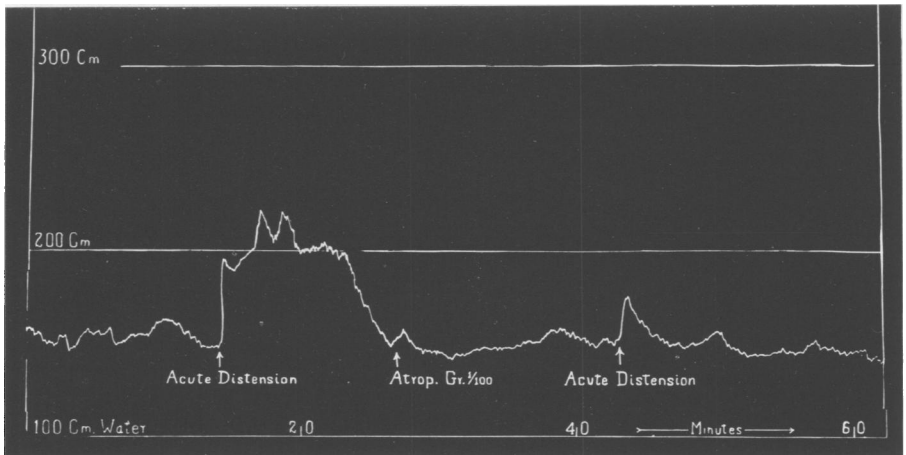


FIG. 8.—Effect of sudden distention of the common bile duct in the human through a cystic duct tube. Reflex spasm of the sphincter of Oddi raises the resistance to flow from 150 mm. to 225 mm. of water. The effect lasts about 10 minutes. Previous atropinization reduces this reflex spasm.

The actual sectioning of the sphincter is a somewhat exacting procedure. The papilla is difficult to find and when the muscle is in spasm the orifice may be extremely small. The best approach is through the common bile duct. An instrument* described by Colp and Doubilet⁹ for performing this operation without opening the duodenum has been used successfully in those patients whose sphincters are not in marked spasm or in whom there is no marked distortion or narrowing of the common duct. The duodenum may be opened over an instrument or over a probe. The muscle is then cut over the probe for about 1 cm. in the anterior free or intraluminal portion of the duct. The retraction of the sphincter muscle fibers prevents healing or regeneration of the muscle.

CASE SUMMARIES

Case No. 1—M.H. (Bellevue Hospital, No. 10199-47) was a 51-year-old female with a 22-year-old history of attacks of severe epigastric pain, lasting from 1 to 7 days, and increasing in frequency until they occurred every two weeks. In addition, there

* Manufactured by The American Cystoscope Makers, New York, N. Y.

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was almost daily transient epigastric pain after meals. Cholecystectomy was performed 20 years ago, and a choledochostomy and duodenostomy 7 years ago for an attack accompanied by jaundice. At that operation the jaundice was found to be due to a pancreatitis. She was admitted to Bellevue Hospital on February 24, 1947 during an attack of severe epigastric and left upper quadrant pain, associated with fever and paralytic ileus. At no time was the serum amylase elevated. The secretin test showed

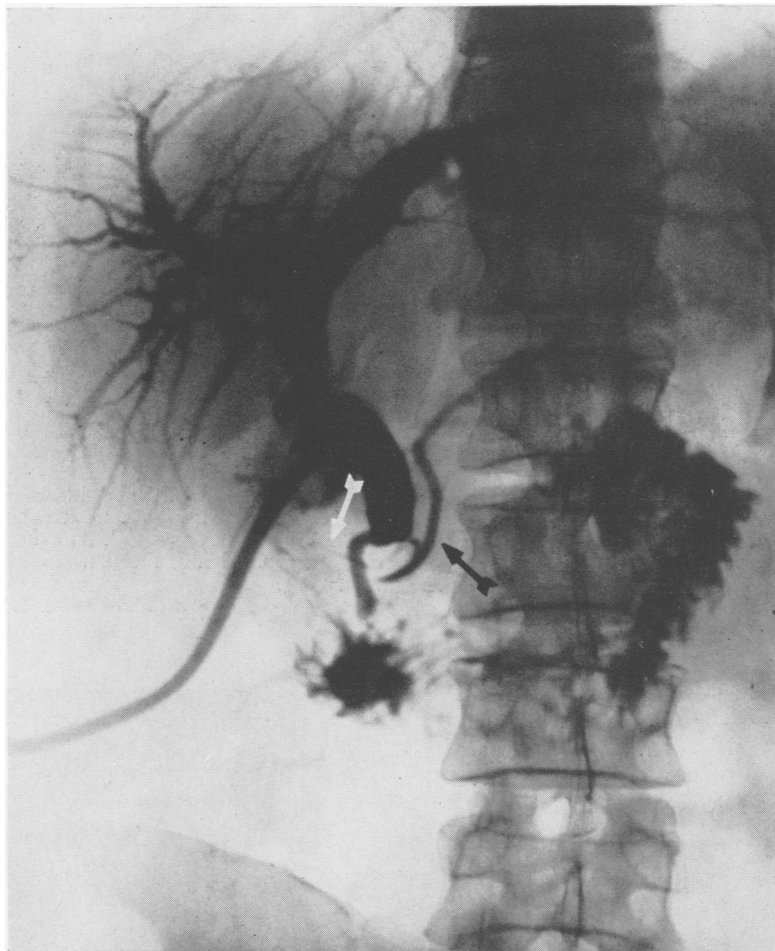


FIG. 9.—Cholangiogram performed through a T tube in the common duct. Sudden distention of the common duct by contrast medium causes pain and reflex spasm of the sphincter of Oddi. In this patient, due to a common passage, the contrast medium was forced up the main pancreatic duct (black arrow) and into the accessory pancreatic duct (white arrow) which can be seen to empty into the duodenum proximal to the papilla of Vater.

diminished function (total volume 104 cc; amylase 125 units). X-ray examination of the stomach and duodenum was reported normal.

At operation on March 24, 1947 the pancreas was uniformly enlarged and indurated. The common bile duct was moderately dilated. A cholangiogram showed pancreatic reflux when spasm of the sphincter of Oddi was induced by acid. Endo-

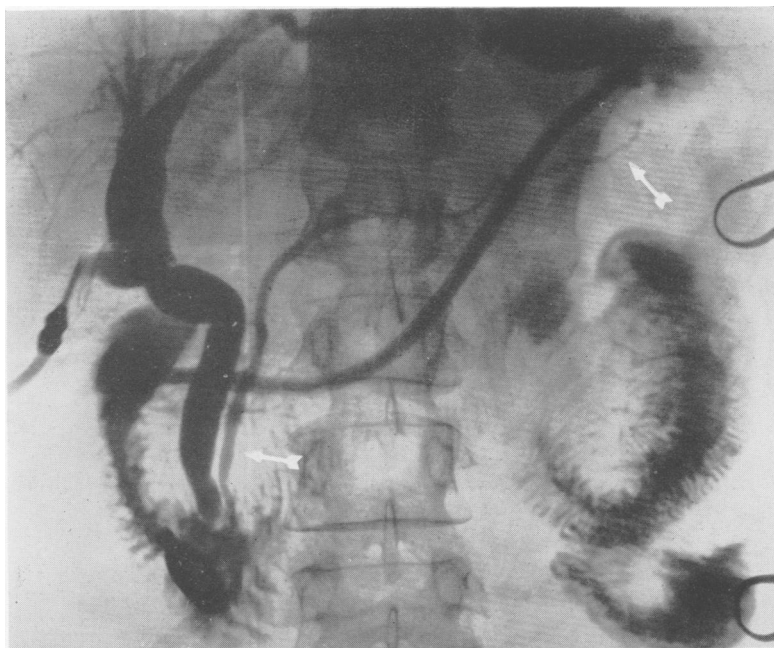


FIG. 10.—(Case 16) Operative cholangiogram in a patient with recurrent acute pancreatitis. Contrast medium injected through a needle in the cystic duct at the same time as hydrochloric acid was applied to the papilla of Vater through a duodenal tube, was forced into the pancreatic duct, visualizing it throughout its length. (arrow).

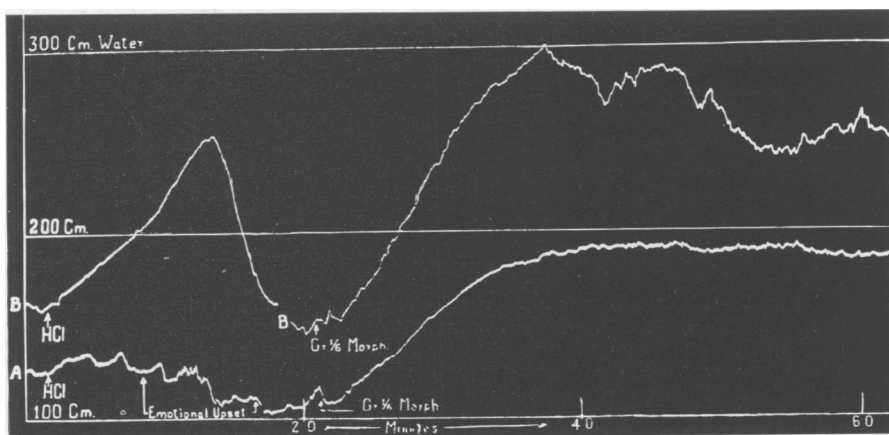


FIG. 11.—(Case 1) Kymographic tracing (A) recorded through a T tube in the common duct of the resistance to flow of bile into the duodenum in Case No. 1, indicates that the sphincter of Oddi is destroyed functionally since there is no response either to local application of acid or to emotional stimuli. The response to morphine is limited to its action on duodenal musculature. This tracing can be compared to the response of the intact sphincter to acid and morphine (B, superimposed).

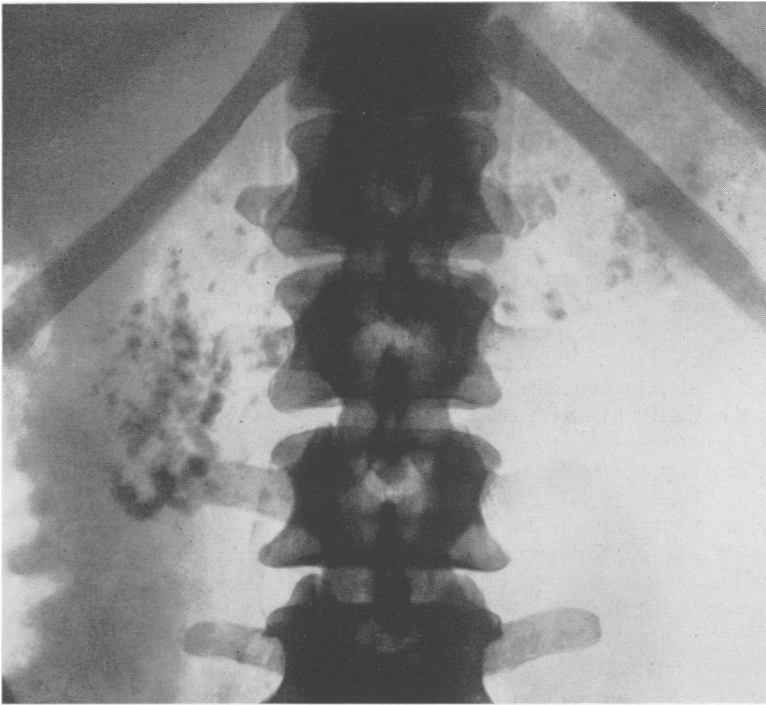


FIG. 12.—(Case 15). Calcification of the pancreas.

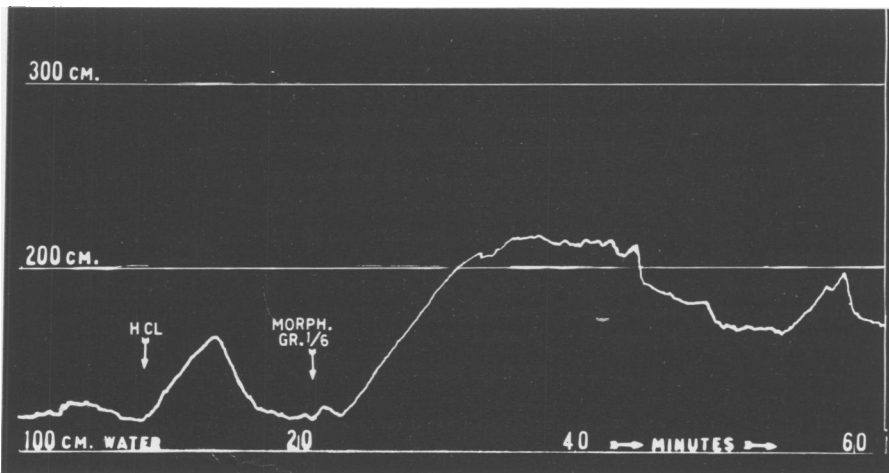


FIG. 13.—(Case 15). Kymographic tracing, recorded through a T tube in the common duct, of the resistance to flow of bile into the duodenum 2 weeks after sphincterotomy, reveals incomplete section of the sphincter of Oddi, since there is a mild response to hydrochloric acid. The response to morphine however, shows adequate destruction of the sphincter muscle.

choledochal sphincterotomy was performed and the common duct drained by a T tube. Two weeks after operation, cholangiographic studies using hydrochloric acid failed to visualize the pancreatic duct, (Fig. 15 and 16) but the use of morphine showed that the intact duodenal wall acted as a one way valve and prevented duodenal reflux. Kymographic studies supported these findings (Fig. 11). The patient has been asymptomatic since operation and has gained 18 pounds in weight.

Case No. 2—L.N. (Bellevue Hospital, No. 14276-47) was a 43-year-old female with a 20-year history of recurrent attacks of severe epigastric pain radiating to the back and to left upper quadrant. Investigations of her stomach, duodenum, esophagus, gall bladder, colon and kidneys were all negative except for gastric achlorhydria. A secretin test showed reduced function of the pancreas, (total volume 60 cc, total amylase 18 units). At operation on April 7, 1947, some adhesions around the gall bladder were found. The pancreas was normal to palpation. A chlangiogram failed to visualize the pancreatic duct. Cholecystectomy and endocholedochal sphincterotomy was done. Postoperatively, there was little drainage through the T tube, due to the fact that the distal part of the cross arm was twisted and occluded. A cholangiogram performed immediately after the removal of the T tube showed a narrowed, irregular common duct emptying readily into the duodenum. The pancreatic duct was not visualized.

The patient was well for 2 months, when she developed several attacks of transient epigastric pain lasting 5 minutes. Eight months after operation she had 2 attacks of severe epigastric pain after eating pork chops. At no time was the serum amylase found elevated. She had other complaints,—pain at the cardiac sphincter on drinking water, globus hystericus, urinary frequency. Sectioning of the sphincter in this patient was ill-advised.

Case No. 3—J.S. (Bellevue Hospital No. 18966-47) was a 57-year-old male with a 9-year history of recurrent attacks of severe epigastric pain radiating to the back and both scapulae, associated with marked gaseous distension and lasting on each occasion from 2 to 7 days. A cholecystectomy was performed in this hospital in 1939 for chronic non-calculus cholecystitis. After operation, he developed a wound dehiscence which was repaired. His attacks persisted but observations both on the ward and in the out-patient-department revealed no positive findings. The serum amylase was always low, never rising over 50 mg. %. A secretin test showed normal pancreatic function. By exclusion, a diagnosis of recurrent acute pancreatitis was made. At operation on May 29, 1947 very extensive adhesions of the stomach, duodenum, colon and liver were found. The common duct was very narrow, and the pancreas felt normal to palpation. A cholangiogram, using acid to produce spasm of the sphincter of Oddi, visualized the pancreatic duct. A probe was passed down the common bile duct into the duodenum, and after opening the duodenum, the sphincter was cut under vision. A fine catheter was passed down the common duct into the duodenum and brought out through the wound.

Postoperatively, his wound separated on the 3rd day and a biliary fistula developed, but after a stormy convalescence he was discharged with his wound healed. The patient was seen on the 18th of May, 1948. He had gained 50 pounds in weight; he had no pain; was eating without any restriction and is a completely rehabilitated person.

Case No. 4—J.B. (Bellevue Hospital, No. 26094-47) was a 47-year-old female, first admitted on September 17, 1945 with a 3-week history of recurrent attacks of severe epigastric and right upper quadrant pain, each attack lasting from 3 to 24 hours and accompanied by fever and leucocytosis. At that time a cholecystogram failed to visualize the gallbladder. She was discharged and observed in the out-patient-department. Roentgen ray studies of the stomach, duodenum and gall bladder showed no abnormality except for an irregularity in the duodenum. Typical attacks of pain

persisted. A diagnosis of recurrent acute pancreatitis was made but she was not admitted for operation until, during a very severe attack in May, 1947, the serum amylase was found to be 308 mg. %.

At operation, June 5, 1947, dense adhesions were present around the gall bladder and liver. The pancreas was moderately thickened. The gallbladder was thick and edematous and contained a few small stones. The common bile duct was moderately

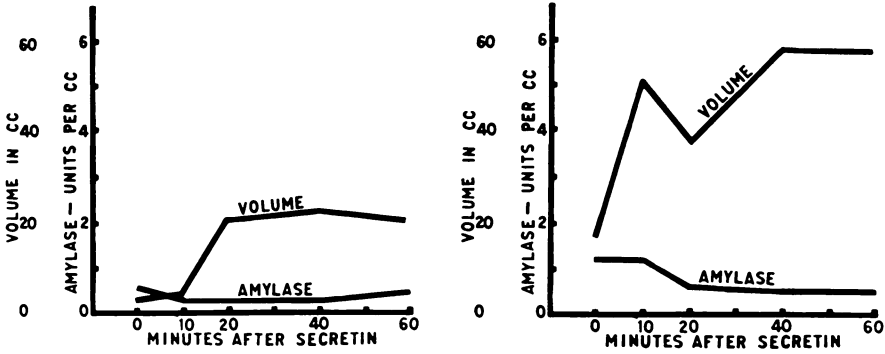


FIG. 14.—(Case 4).



FIG. 15.

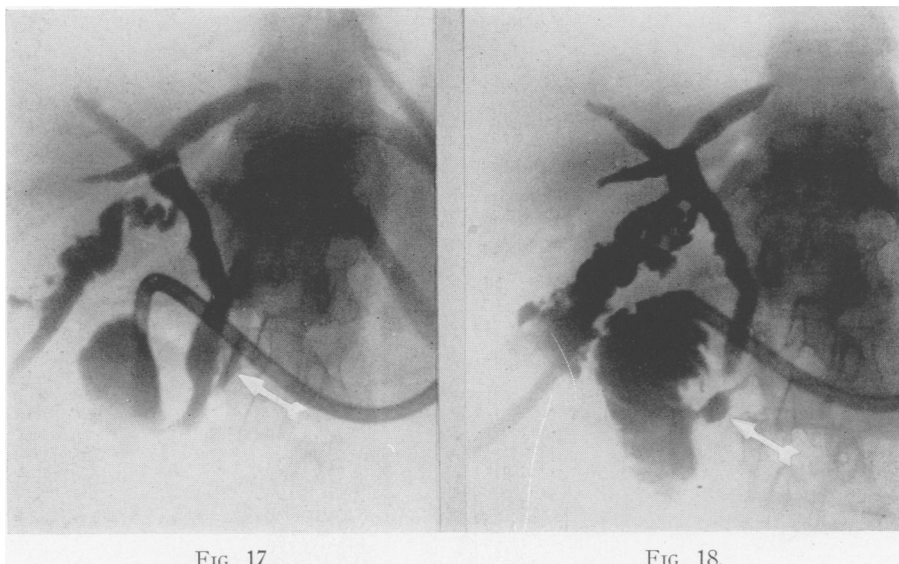
FIG. 16.

FIGS. 15 and 16.—(Case 1.) Cholangiographic studies two weeks after sphincterotomy, shows the free entrance of contrast medium into the duodenum. (Fig. 15) Following application of acid to the duodenum (Fig. 16), the pancreatic duct is not visualized. Under similar conditions prior to sphincterotomy the pancreatic duct was visualized (Fig. 14.)

dilated. Cholangiographic studies showed that the bile and the pancreatic ducts emptied into a common ampulla a considerable distance from the ampulla of Vater (Fig. 17 and 18). Cholecystectomy and endocholedochal sphincterotomy were carried out. Histologic examination of the gall bladder showed acute and chronic cholecystitis. Biopsy of the pancreas revealed mild fibrosis. Two weeks after operation cholangiographic studies visualized the pancreatic duct presumably due to the fact that the junction of

the two ducts was high in the duodenal musculature (Fig. 19). Following the administration of morphine, the intramural parts of the ducts were compressed by the increased tonus of the duodenum, and the pancreatic duct was no longer visualized (Fig. 19). The secretin test showed marked reduction in pancreatic function (Fig. 14). Kymographic tracings indicated functional destruction of the sphincter of Oddi.

Patient has been asymptomatic since operation except for one attack of mild epigastric distress lasting 10 minutes following the eating of pork sausage. She has gained 20 pounds in weight. A secretin test performed 6 month after operation revealed marked improvement in the pancreatic function (Fig. 14).



FIGS. 17 and 18.—(Case 4) Operative cholangiogram through the cystic duct. Contrast medium was injected at the same time as hydrochloric acid was applied to the papilla of Vater through a duodenal tube. The pancreatic duct (arrow) was visualized (Fig. 17). Another view (Fig. 18) demonstrated an ampulla (arrow) high in the duodenal wall into which both ducts emptied.

Case No. 5—W.B., (Bellevue Hospital No. 38441-47) was a 58-year-old male with a 3 months history of epigastric pain radiating to the right upper quadrant and back. This pain was made worse by eating fatty foods. The pain was continuous and superimposed were bouts of very severe pain, vomiting and gaseous distension. Roentgenograms of the stomach and duodenum were normal; gallbladder visualized faintly. At operation on August 18, 1947, the gallbladder, although thin-walled, was adherent by old and fresh adhesions to the omentum, colon and duodenum. No stones were present. The pancreas felt normal. A cholangiogram through the common duct visualized the pancreatic duct (spasm of the sphincter of Oddi produced by hydrochloric acid). On the basis of the dense adhesions and the absence of stones, and the presence of the common passageway, a diagnosis of recurrent pancreatitis was made and the sphincter of Oddi was cut through the common duct. Histologic examination of the gallbladder showed minimal chronic cholecystitis. A cholangiogram 2 weeks after operation did not visualize the pancreatic duct in spite of injection of acid into the duodenum. A kymographic tracing revealed proof of the destruction of the sphincter of Oddi. The secretin test revealed normal pancreatic secretion (total volume 172 cc., total amylase 567 units). Since discharge, the patient has had a feel-

ing of epigastric pressure whenever he is constipated, but no persistent pain or acute attacks.

Case No. 6—M.W. (Bellevue Hospital, No. 40368-47) was a 32-year-old female who was admitted August 23rd, 1947 five days after onset of severe epigastric pain associated with vomiting. Similar attacks had occurred during the previous year. On admission, jaundice was noted (Icteric Index 15) as well as bile and a trace of sugar in the urine. Marked tenderness in the epigastrium and left upper quadrant were present. The serum amylase was 1355 mg. % on August 24th, 514 mg. % the next day, and 56 mg. % 5 days later. A cholecystogram on August 24, 1947 failed to visualize the gall bladder but on Sept. 4, 1947 repetition of the test showed good concentra-



FIGS. 19 and 20.—(Case 4) Cholangiogram done through a T-tube 2 weeks after operation. The pancreatic duct (arrow) was filled with contrast medium (Fig. 19) in spite of section of the sphincter because of an unusually high junction of the bile and pancreatic ducts. Morphine (gr. 1/6) increased the tonus of the whole duodenal wall and compressed the junction of the two ducts, preventing further reflux (Fig. 20).

tion and evacuation. Roentgenogram of the stomach and duodenum showed no abnormality. A secretin test showed normal pancreatic function (total volume 187 cc; total amylase 336 units). At operation on September 11, 1947 after separating adhesions around the liver, the gallbladder was found to be relatively normal; the common bile duct was twice the normal diameter; the pancreas was slightly indurated. A cholangiogram visualized the pancreatic duct. Cholecystectomy and endocholedochal sphincterotomy were performed. Cholangiography 2 weeks later performed through a T tube failed to visualize the pancreatic duct. Kymographic tracings of the resistance of the sphincter of Oddi indicated destruction of its function.

Patient seen on the 18th of May, 1948, gained 15 pounds in weight. Her complaint was that her increase in appetite and unrestricted diet was promoting too rapid gain in weight.

Case No. 7—G.B. (Bellevue Hospital, No. 46408-47) was a 43-year-old female with a 9-year history of recurrent attacks of moderate epigastric pain, lasting from ½ to 1 hour and relieved by vomiting. She had lost 15 pounds in weight because her food intake was restricted, since food brought on the attacks. Her gallbladder had

been removed at another hospital 13 years previously for cholelithiasis. She was admitted to this hospital on May 7, 1947, three days after a severe attack of epigastric pain radiating to the right upper quadrant, fever and vomiting. A serum amylase of 740 mg. % confirmed the diagnosis of acute pancreatitis. Roentgenogram of the stomach and duodenum revealed no abnormality. Patient was discharged and followed in the out-patient-department. Because of daily post-prandial pain and recurrent severe attacks, she was readmitted on October 2, 1947. A secretin test showed normal pancreatic function (total volume 185 cc; total amylase 367 units). At operation, the common bile duct was found moderately dilated; the pancreas firm but not enlarged; a hard mass was palpated in the lesser curvature of the stomach which was



FIG. 21. — (Case 7) Cholangiogram through a T tube 2 weeks after sphincterotomy, visualized the pancreatic duct (arrow). As in Case 4, the high junction of the bile and pancreatic ducts permitted filling of the pancreatic duct in spite of sphincterotomy.

opened; a small, deep gastric ulcer was found and excised. A cholangiogram failed to visualize the pancreatic duct, possible due to the fact that the end of the duodenal tube through which the acid was injected was not adjacent to the papilla. The common duct was opened and endocholedochal sphincterotomy performed. A cholangiogram performed 2 weeks after operation through the T tube visualized the pancreatic duct, (Fig. 21). A kymographic tracing, using acid and morphine, indicated destruction of the sphincter of Oddi.

The patient has been symptom free since operation.

Case No. 8—F.R. (Bellevue Hospital. No. 47498-47) was a 27-year-old female with a 3-year history of recurrent attacks of severe, mid-abdominal pain radiating to the epigastrium and left upper quadrant, occurring at varying intervals from daily to monthly, lasting from 2 hours to 1 week and accompanied by fever and tenderness in the epigastrium and left upper quadrant. Her last attack started 5 days before admission to the Third (New York University) Medical Division of Bellevue Hospital, October 9, 1947. Examination at this time revealed (1) jaundice (Icteric Index 22, bile in urine); (2) paralytic ileus (distended small bowel with fluid levels by

Roentgen ray); (3) diaphoresis with acidosis (blood sugar 250 mg. F, sugar and acetone in urine, carbon dioxide combining power in blood, 30 volume %); (4) hypertension (B.P. 158/96); (5) albumin in urine; (6) serum amylase over 300 mg. %.

Under treatment by intestinal suction, atropine, intravenous fluids and insulin all symptoms disappeared within 1 week. A cholecystogram 3 weeks after onset of attack visualized the gall bladder. Roentgenogram of the stomach and duodenum showed normal findings. The patient was transferred to the surgical service on November 1, 1947. A secretin test showed diminished pancreatic function (volume 91 cc.; amylase 92 units). At operation on November 7, 1947, a thin-walled gallbladder surrounded by dense adhesions was found; the pancreas was hard, enlarged to at least twice its normal size, and showed areas of old diffuse hemorrhage beneath its capsule. A cholangiogram visualized the pancreatic duct. The common bile duct was very narrow.

After cholecystectomy, the duct was opened and a fine probe passed into the duodenum, which was opened over the probe. The sphincter was sectioned and a fine catheter passed up the bile duct and out through the lateral angle of the wound. The duodenum was then closed. The catheter was dislodged accidentally on the 14th day and a cholangiogram, performed, immediately afterwards through the fistula, visualized the pancreatic duct (Fig. 22). The fistula closed the next day and the patient was discharged 16 days after operation. Histologic examination of a biopsy of the pancreas



FIG. 22.—(Case 8) Cholangiogram through a fistula two weeks after transduodenal sphincterotomy demonstrated a narrow common bile duct and filling of the pancreatic duct, due to its high entrance into the common duct.

showed a marked inflammatory reaction and replacement of acinar tissue by extensive fibrosis. She has been asymptomatic since operation, in spite of relapsing to old habits of periodic alcoholic sprees. She has gained 20 pounds in weight.

Case No. 9—R.G. (Bellevue Hospital, No. 24620-47) was a 27-year-old female with a 4-year history of recurring attacks of epigastric pain radiating to the back and to both upper quadrants and lasting 10 to 30 minutes. Roentgenogram of the gallbladder showed a functioning viscus with stones. At operation on May 27, 1947, a moderately thickened gallbladder containing many stones was removed. A cholangiogram performed through the cystic duct visualized the pancreatic duct (Fig. 23 and

FIG. 23.

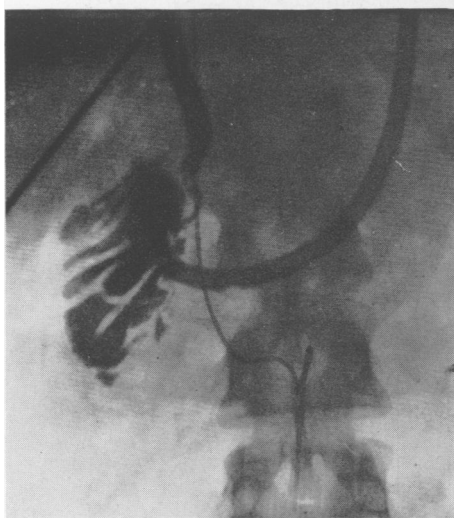


FIG. 24.



FIG. 25

FIGS. 23, 24 and 25.—(Case 9) Operative cholangiogram at first operation (cholecystectomy for chronic calculous cholecystitis) visualized a high junction of the pancreatic duct (arrow) with the common bile duct when the sphincter of Oddi was made spastic by acid (Fig. 23). When the acid was washed away (Fig. 24) the pancreatic duct could not be visualized in spite of the continued injection of contrast medium. The relaxation of the duodenal wall was evident. A postoperative cholangiogram (Fig. 25) through a T-tube after the second operation (transduodenal sphincterotomy) again visualized the pancreatic duct (arrow), a common finding in the presence of a high junction of the bile and pancreatic ducts.

24). The cystic duct was then tied and the abdomen closed. The patient was discharged on the 9th postoperative day; that night she ate fried liver and was readmitted to the hospital during an attack of severe epigastric pain. The serum amylase was 595 mg. %. The symptoms subsided and 2 days later the serum amylase was 176 mg. %. She was discharged and followed in the out-patient-department. She remained well for 5 months and then increasingly severe attacks recurred. At re-operation on December

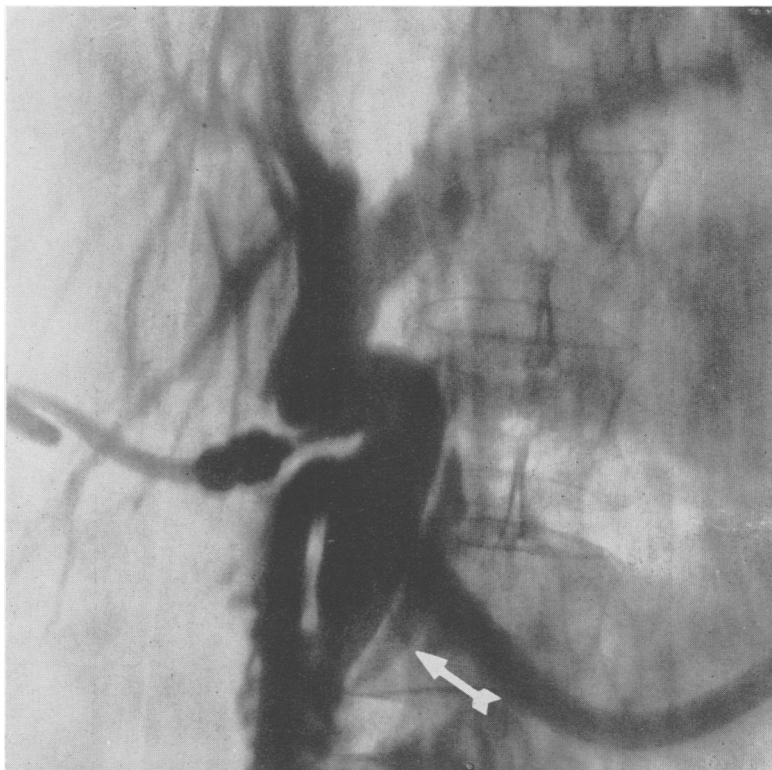


FIG. 26.—(Case 10). Operative cholangiogram through the cystic duct visualized the markedly dilated common bile duct and a dilated pancreatic duct (arrow). Spasm of the sphincter of Oddi was produced by acid applied to the papilla of Vater.

27, 1947, the sphincter of Oddi was cut transduodenally. A cholangiogram taken 2 weeks after operation visualized the pancreatic duct again (Fig. 25). Following administration of morphine, the pancreatic duct could no longer be visualized. Kymographic tracings indicated destruction of the sphincter of Oddi.

Since discharge from the hospital the patient complains of post-prandial pain lasting from 5 to 10 minutes, gradually decreasing in intensity. She is not symptom free as yet.

Case No. 10—A.W. (Bellevue Hospital, No. 387-48) was a 54-year-old female with an 8-year history of recurrent attacks of mid-abdominal and epigastric pain lasting from 1 to 3 days. She was admitted on December 6, 1947, three days after onset of a severe attack. The serum amylase was 382 mg. %, white blood count 18,000; the abdomen was distended and there was gas and fluid levels in the small bowel by Roentgen ray. There was also marked tenderness in the epigastrium and left upper quadrant. The symptoms disappeared in 2 days and the serum amylase

dropped to 75 mg. % 8 days after onset. The gallbladder failed to visualize, but radio-opaque stones could be seen. A secretin test revealed marked impairment of the pancreatic function (total volume 70 cc.; total amylase 235 units).

At operation, January 5, 1948, the colon, stomach and duodenum were found adherent to the gallbladder which was distended and full of small, black stones. The common bile duct was three times the normal size; the pancreas was firm but not unduly enlarged. Cholangiography visualized the pancreatic duct (Fig. 26). Cholecystectomy and endocholedochal sphincterotomy were performed. The patient de-



FIG. 27.—(Case 12). Postoperative cholangiogram through a T tube in the common bile duct visualized the pancreatic duct for a short distance with a primary branch (arrow). There was a dilatation of the portion of the duodenum proximal to the papilla with narrowing of the distal segment, possibly a factor in the pain this patient experienced after operation.

veloped shock-like symptoms during the operation which persisted with complete anuria until 3 days after operation when she died. The diagnosis of mismatched transfused blood was confirmed by histological examination of a section of the kidney.

Case No. 11—H.W. (Bellevue Hospital, No. 906-48) was a 49-year-old white male, admitted on January 6, 1948. In 1940 a cholecystectomy had been performed for acute gangrenous cholecystitis with stones; the patient was well except for intolerance to fatty foods and post-prandial gaseous distension until November, 1947, when he began to suffer from attacks of very severe epigastric and right upper quadrant pain radiating to the back, often accompanied or followed by periods of frothy diarrhea. In between these attacks he had epigastric pain after almost every meal, and became afraid to eat.

RECURRENT ACUTE PANCREATITIS

A secretin test on January 6, 1948 revealed marked impairment of pancreatic function (volume 40 cc., total amylase 88 units).

At operation on January 8, 1948, dense adhesions were found at the porta hepatis. The common duct was twice its normal size. The pancreas was enlarged and hard in its entire length. A cholangiogram showed a dilated common duct but failed to visualize the pancreatic duct; no evidence of the previously drained gallbladder could be seen. The common duct was opened and endocholedochal sphincterotomy performed. The common duct was closed and a small drain placed close to it. Convalescent was uneventful and attacks of pain ceased. He has had no diarrhea since



FIG. 28.—(Case 14). Operative cholangiogram through a needle in the cystic duct visualized the whole length of the pancreatic duct (arrows). The bucket of the duodenal tube through which acid was applied, can be seen lying against the papilla.

the operation. However, 3 months later he complained of a steady aching pain in the right side of the abdomen radiating across to the left side. Up to the present time, the cause of this pain has not been determined. A secretin test on May 12, 1948 showed marked improvement in pancreatic function (total volume 88 cc., total amylase 135 units.).

Case No. 12—M.L. (Bellevue Hospital, No. 659-48) was a 34-year-old female who had a chronically inflamed gall bladder with stones removed in 1941. The attacks of severe epigastric pain, radiating to the back and both upper quadrants from which she had suffered for 5 years prior to operation, recurred 9 months after operation and for 6 months had been so severe and so frequent as to incapacitate her. Under observation on the ward she developed 2 severe attacks of epigastric pain associated with marked tenderness in the upper left quadrant. The serum amylase was not elevated. A secretin test revealed normal pancreatic function (total volume 143 cc.; total amylase 497 units). Roentgenograms of the stomach and duodenum showed no abnormality. At operation, January 12, 1948 dense adhesions were found between the liver and the

stomach, duodenum and colon. The pancreas was not unduly indurated. The remnant of the cystic duct, 2" long, was isolated and removed. The common duct was dilated twice its normal size. A cholangiogram failed to visualize the pancreatic duct. The common duct was opened and the sphincterotome passed to the papilla, but it could not be pushed into the duodenum without undue force. The duodenum was opened and the papilla found tightly contracted. It was dilated and the sphincterotome pushed through under vision and the sphincter sectioned. The duodenum was closed and the common bile duct drained by a T tube. Cholangiographic studies 2 weeks later visualized the pancreatic duct, but showed marked narrowing of the duodenum

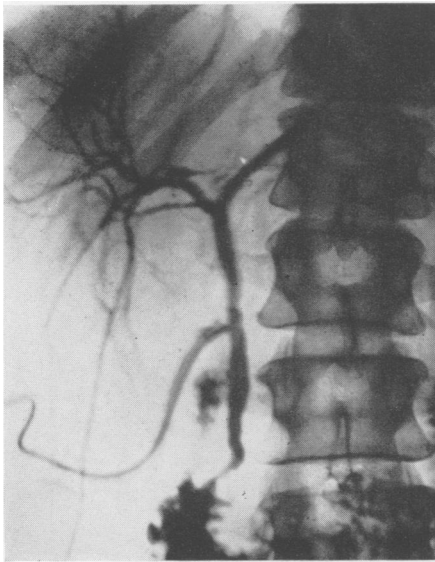


FIG. 29.



FIG. 30.

FIGS. 29 and 30.—(Case 14). Cholangiographic studies carried out through a T tube two weeks after sphincterotomy. Sudden painful distention of the common duct with contrast medium failed to produce spasm of the sphincter of visualization of the pancreatic duct (Fig. 29). After morphine injection the cholangiogram demonstrated compression of the terminal part of the common duct by the increased tonus of the duodenal wall, showing that its one-way valve action was intact (Fig. 30).

with dilatation of the first part evidently as the result of opening the duodenum (Fig. 27). Kymographic studies indicated destruction of the sphincteric function.

Since operation, the patient has complained of attacks of transepigastric pain lasting from 5 to 10 minutes, and occurring after meals. When last seen she stated that the attacks have been decreasing in frequency and severity but she still had some tenderness on pressure in the epigastrium.

Case No. 13—D.C. (Bellevue Hospital, No. 43131-46) was a 38-year-old female, first admitted on September 10, 1946, 3 days after onset of an attack of acute pancreatitis associated with jaundice and serum amylase of 256 mg. %. The attack subsided rapidly but recurred following a fatty meal (Fig. 1). A cholecystogram failed to visualize the gall bladder, but several radio-opaque stones could be seen in the region of the common duct. At operation, October 3, 1946, a thick-walled gall bladder filled with stones was removed. The common bile duct was indurated, enlarged and contained 4 stones. A cholangiogram failed to visualize the pancreatic duct but the intravenous injection of secretin was followed by the appearance of pancreatic juice in the common duct, thus proving the presence of a common passageway. It was felt

that the pancreatitis was due to obstruction of the papilla of Vater by a stone and was not due to spasm. Accordingly, the sphincter of Oddi was not sectioned.

The patient was free of symptoms for one year when attacks of epigastric pain recurred and increased in frequency. Roentgenogram of the stomach and duodenum revealed no abnormality. Re-operation January 23, 1948 revealed 3 more stones in the common duct, apparently missed at the first operation. They caused no jaundice but



FIG. 31.—(Case 15). Operative cholangiogram through a needle in the cystic duct failed to visualize the pancreatic duct. The common bile duct was dilated and its retroduodenal course distorted by the calcified pancreas (Fig. 12).

possibly reflex spasm of the sphincter had resulted in recurrent attacks of pancreatitis. A cholangiogram revealed the pancreatic duct emptying into the ampulla low down near the papilla. Palpation of the stomach disclosed a thickening at the lesser curvature on the posterior wall. The stomach was opened and a large, shallow ulcer, 1.5 cm in diameter was seen. It appeared to be benign but a biopsy was taken to confirm this. The opening in the stomach was closed. Endocholedochal sphincterotomy was then performed. Two weeks after operation, a cholangiogram visualized the terminal part of the pancreatic duct. Kymographic studies indicated the destruction of the sphincter of Oddi. Biopsy of the gastric ulcer was reported a benign.

Roentgenological examination on May 11, 1948 revealed a defect in the gastric wall which may be a persistent ulcer (although the patient has been well and gaining weight) or a recurrence.

Case No. 14—O.T. (Bellevue Hospital, No. 12709-47) was a 44-year-old male addicted to alcoholic sprees following which, during the past 3 years, he would develop very severe attacks of epigastric and right upper quadrant pain, abdominal distension and vomiting. He was admitted to a number of different hospitals for this condition but no accurate diagnosis was made until, during an admission to Bellevue Hospital in March, 1946, a diagnosis of recurrent acute pancreatitis was made on the basis of serum amylase determinations (Fig. 36). Roentgenogram of the gall bladder, stomach and duodenum showed no abnormality. He left the hospital when his symptoms subsided but, after several more attacks, returned for operation. A secretin test

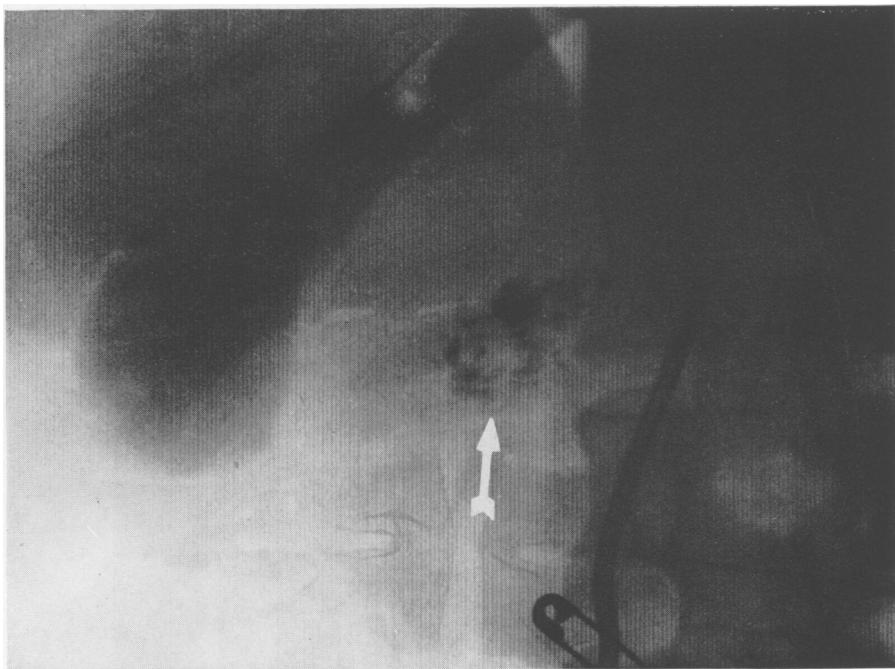


FIG. 32.—(Case 19). The cholecystogram demonstrated a normal gallbladder and calcification in the head of the pancreas (arrow). The tube visible in this film lay in the pancreatic fistula to the skin.

showed normal pancreatic function (total volume 271 cc.; total amylase 638 units).

At operation on Feb. 11, 1948 dense adhesions were found between the liver and the adjacent organs. The gallbladder was thin-walled and contained no stones. The pancreas was firm. The common duct was normal in diameter. A cholangiogram visualized the whole pancreatic duct (Fig. 28). Cholecystectomy and endocholedochal sphincterotomy were performed. Cholangiographic studies 2 weeks after operation failed to visualize the pancreatic duct under spasm of the sphincter produced by pain (Fig. 29). After morphine administration, the function of the intact duodenal wall as a one-way valve could be seen to be intact (Fig. 30). Kymographic studies were further evidence of destruction of the sphincter of Oddi.

The patient had no further attacks of pancreatitis as observed during subsequent hospital admission for alcoholism.

Case No. 15—F.J. (Bellevue Hospital, No. 4485-48) was a 50-year-old male with a 13-year history of attacks of severe upper mid-abdominal pain, radiating to the epigastrium and left upper quadrant, lasting 2 hours to 2 days and occurring 2

to 3 times a month. These attacks followed a big meal and were most severe if food were taken after a prolonged alcoholic spree. There was no history of diarrhea. Roentgenograms of the abdomen revealed widespread calcification of the pancreas (Fig. 11); X-ray of the gall bladder showed normal visualization; and of the stomach and duodenum was reported as suggestive of duodenal ulcer. The glucose tolerance curve was normal. A secretin test showed diminished volume response of pancreatic juice flow but fairly good amylase concentration (total volume 105 cc.; total amylase 297 units). Since the symptoms were similar to those of non-calcified recurrent acute pancreatitis, and since he had good external and internal pancreatic function, it was decided to treat him as recurrent acute pancreatitis.

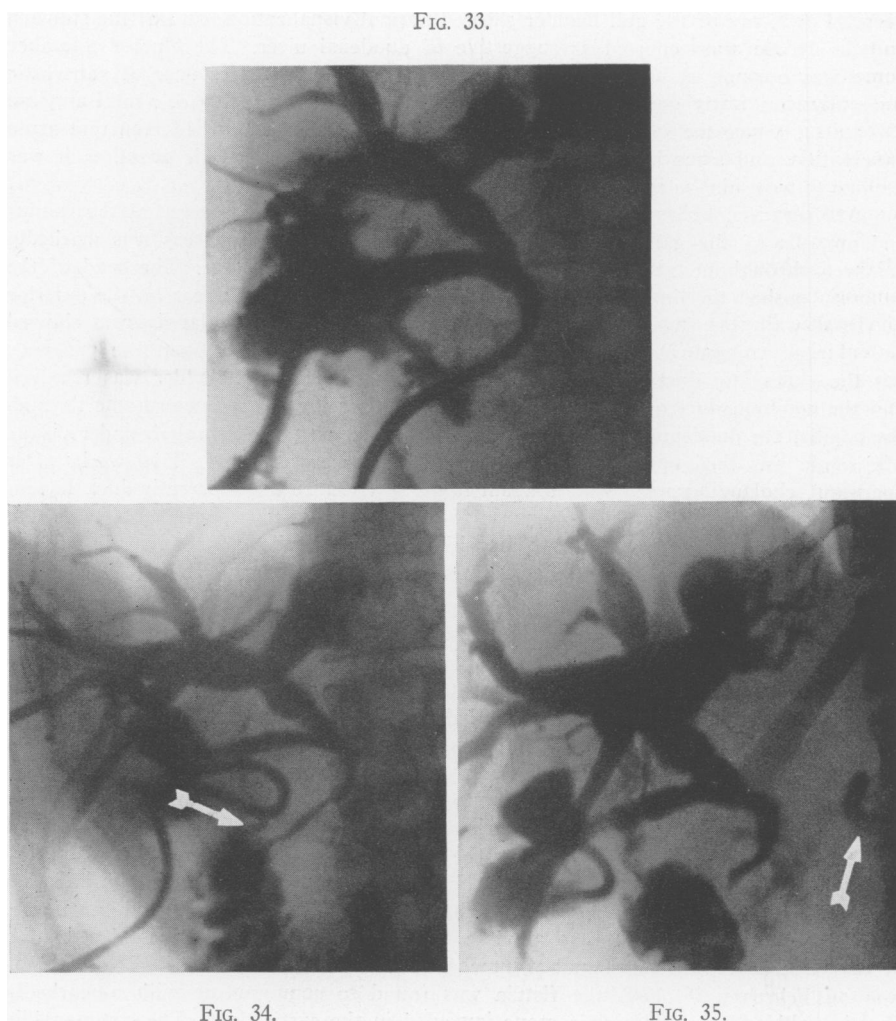
At operation, February 19, 1948, only a few adhesions were present at the fundus and ampulla of the gallbladder which was thin-walled. The pancreas was markedly enlarged throughout, very hard, and with cobble-stone-like surface. The head of the pancreas pushed the duodenum forward and distorted it. A thin scar on the anterior duodenal wall was suggestive of a healed duodenal ulcer. A cholangiogram showed an enlarged common bile duct with distortion due to pressure from the pancreas, but the pancreatic duct was not visualized (Fig. 31). The gallbladder was removed and the common duct opened. Due to difficulty in passing the sphincterotome through the papilla, the duodenum was opened and the instrument passed through under vision. The blade was then opened, retracted and the sphincter sectioned. Two weeks after operation, cholangiographic studies again failed to visualize the pancreatic duct. Kymographic studies showed a slight response to acid indicating possibly incomplete section of the sphincter but the response to morphine showed excellent functional destruction (Fig. 13). The patient has had no symptoms since operation but the acid test of an alcoholic bout has not yet been applied.

Case No. 16—C.R. (Bellevue Hospital, No. 7790-48) was a 29-year-old female with a 6-year history of recurrent monthly attacks of severe epigastric pain associated with nausea and vomiting, and radiating to both upper quadrants and to the back. Repeated Roentgenograms of the gallbladder, stomach and duodenum showed no abnormality. Exploratory laparotomy at another hospital during an acute attack in 1943 revealed acute pancreatitis. Cholecystostomy and drainage of the pancreas were performed. Drainage from the cholecystostomy site persisted intermittently for the intervening 5 years and, at one time during the course of this biliary drainage, a small cholesterol stone was extruded. When the fistula closed the attacks recurred.

She was admitted to this hospital on February 15, 1948. Contrast medium injection of the fistula revealed a small cavity which appeared to hold a radio-translucent stone. The drainage fluid contained no amylase. A secretin test showed marked reduction in the pancreatic function (total volume 42 cc.; total amylase 43 units). At operation on February 25, 1948, the fistula was found to communicate with a markedly fibrotic gallbladder containing a stone impacted in the cystic duct. The common bile duct was at least twice its normal size. The pancreas was hard throughout and moderately enlarged. A cholangiogram visualized the whole pancreatic duct (Fig. 10). Cholecystectomy and endocholedochal sphincterotomy were performed. The common duct was closed and a small drain, which was removed 4 days after operation, placed down to it.

Patient has been completely symptom free since operation.

Case No. 17—J.D. (Bellevue Hospital No. 8639-48) was a 32-year-old male with a 5-year history of frequent recurrent attacks of severe upper abdominal pain, sudden in onset, originating in peri-umbilical region and spreading up to the epigastrium and both upper quadrants and to back, accompanied by nausea and vomiting (bloody on 2 occasions) and lasting from 2 to 3 weeks. No diarrhea following these attacks. In November, 1946, a cholecystectomy was done but the attacks persisted. In 1947, at another hospital, a diagnosis of acute pancreatitis was made (serum amylase



FIGS. 33, 34 and 35.—(Case 19). Postoperative cholangiogram showed the catheter passing down the common bile duct into the duodenum (Fig. 33). Following partial withdrawal of catheter, the distorted narrowed common bile duct could be visualized (Fig. 34). A long thin shadow (arrow) to the right of the common duct might be the pancreatic duct but the distortion due to calcification of the head of the pancreas made this uncertain. Following administration of morphine (Fig. 35) the terminal part of the common duct was constricted by the increased tonus of the duodenal wall. The tube (arrow) lying in the pancreatico-gastrostomy was visualized.

281 mg. %) and confirmed by exploratory laparotomy. In February, 1948 a similar attack (amylase 209 mg. %) was observed. He was admitted to Bellevue Hospital February 19, 1948 at which time gastro-intestinal Roentgenologic findings were normal. Secretin test showed diminished function (total volume 132 cc.; total amylase 135 units). At operation on March 4, 1948, dense adhesions were found in the upper abdomen. The common duct was dilated 3 times its normal size; the pancreas was hard and enlarged throughout. An operative cholangiogram was unsatisfactory and failed to reveal the pancreatic duct. The common duct was opened and the sphincterotome passed. The duodenum was then opened and the sphincter of Oddi sectioned by the sphincterotomy under vision. The duodenum was closed and a T tube placed in the common duct.

Two weeks after operation a kymographic tracing showed evidence of destruction of the sphincter (no response to acid and diminished response to morphine). A cholangiogram showed ready entrance of contrast medium into the duodenum and failed to visualize the pancreatic duct. The T tube was removed on March 24, 1948 and the patient was discharged. He has had no symptoms since operation.

Case No. 18—J.W. (Holy Name Hospital, Teaneck, N. J., operation with Dr. Walter J. Farr) was a 53-year-old male with a 6-year history of attacks of right upper quadrant pain lasting 8 to 10 minutes. In 1944 a cholecystectomy was performed for stones. He was well for 6 months when extremely severe attacks in the right upper quadrant recurred, lasting from 10 minutes to 6 hours, and occurring 2 to 3 times a week. A diagnosis of recurrent acute pancreatitis was made. At operation, the pancreas was found to be enlarged and rock-like in consistency throughout its whole extent. The common bile duct was about 3 times its normal diameter with a thickened inflamed wall. Endocholechal sphincterotomy was done and the common bile duct closed. A small rubber drain was placed down to the duct and removed 3 days later.

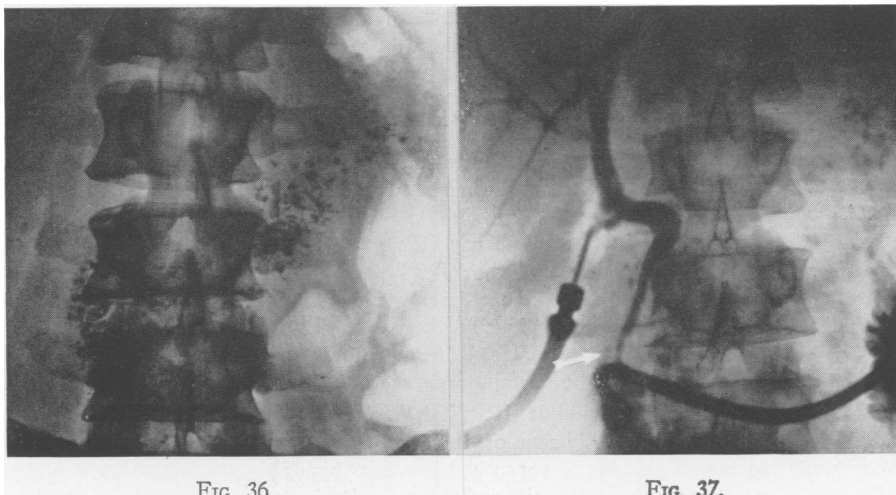
The patient has been free of symptoms since operation.

Case No. 19—J.G. (Bellevue Hospital, No. 906-48) was a 36-year-old male admitted to the psychiatric division of Bellevue Hospital on February 24, 1948 in a semi-stuporous condition due apparently to insulin hypoglycemia. He had a history of attacks of severe epigastric pain radiating to the back for 11 years. In 1940 an operation, cholecystostomy and drainage of a pancreatic cyst for obstructive jaundice due to the cyst, was performed. After 2 years the attacks of severe epigastric pain recurred and he became a morphine addict. In 1945, at another hospital, following studies which indicated marked diminution of pancreatic function, an attempt to do a pancreatectomy was abandoned and a splenectomy and drainage of a pancreatic cyst was carried out. He developed a persistent pancreatic fistula and attacks of epigastric pain persisted. After this operation a pancreatic-colic fistula was demonstrated but this apparently closed. At this time, the patient developed diabetes for which he required 40 Units of Insulin. He continued to have attacks of severe pain associated with paralytic ileus on occasion.

Studies at Bellevue Hospital revealed a severe diabetes (glucose tolerance curve: 173,235,333,308 mg. % sugar at ½ hour intervals). Injection of the pancreatic fistula visualized part of the pancreatic duct and showed free communication with the duodenum. Roentgenogram of the stomach and duodenum revealed a normal stomach with some obstruction of the duodenum. Secretin tests could not be done due to failure to pass a duodenal tube. Roentgen-ray studies revealed a normal functioning gallbladder as well as calcification in the head of the pancreas (Fig. 32). He required frequent injections of demerol for pain and to alleviate morphine withdrawal symptoms.

At operation on April 5, 1948 the stomach, duodenum and colon were found to be adherent to the liver. The gallbladder was surrounded by dense adhesions. The pancreatic fistula communicated with the body of the pancreas which was thickened and fibrosed with the head hard, irregular and enlarged. Many large veins coursed around

and over the gastrohepatic omentum, duodenum and pancreas. The common duct was located only after a cholangiogram was done through the cystic duct following removal of the gallbladder. The common duct was wide above and tortuous in its passage behind the head of the pancreas. The pancreatic duct was not visualized. The common duct was opened and a fine probe passed into the duodenum. The duodenum was opened and the sphincter of Oddi was cut transduodenally over the probe. A fine catheter was passed into the duodenum through the bile duct and brought out at the lateral angle of the wound. The pancreatic fistula was excised. The opening which remained in the main pancreatic duct was anastomosed to the overlying stomach over a small rubber tube. Cholangiograms taken 2 weeks after operation showed ready entrance of the contrast medium into the duodenum (Figs. 33 and 34). Following injection of morphine the duodenal musculature was shown to be intact (Fig. 35). Patient



FIGS. 36 and 37.—(Case 21). Calcification of the pancreas (Fig. 36) and operative cholangiogram through a needle in the cystic duct (Fig. 37). The angulation and narrowing of the bile duct in its passage behind the calcified head of the pancreas was noteworthy. A questionable shadow (arrow) may be the pancreatic duct.

has been asymptomatic since discharge, requiring no demerol and the pancreatic fistula has remained closed.

Case No. 20.—D.P. (French Hospital No. 138622) was a 31-year-old female with a 12-year history of attacks of epigastric pain radiating to the back over the 10th rib and to the left upper quadrant. The post-prandial pain has become so frequent that fear of eating led to a loss of 16 pounds in the last 6 months. Appendectomy was performed 12 years ago, and the removal of the right cystic ovary 6 years ago, without alleviating attacks. Complete physical and Roentgen-ray examinations at various hospitals failed to establish any diagnosis. A secretin test showed over 50% loss in pancreatic function (total volume 66 cc.; total amylase 325 units). On the basis of this test and the history, a diagnosis of recurrent acute pancreatitis was made. At operation on April 9, 1948, the gallbladder was found to be normal with only a few adhesions to the ampulla. The pancreas felt normal; the common bile duct was about twice its normal size. A cholangiogram was unsatisfactory owing to technical reasons. The gallbladder was removed and the common duct opened. The tip of the sphincterotome was arrested at the papilla and the duodenum was opened. The tip of the instrument was found arrested in a rather large ampulla of Vater due to the fact that the direc-

tion of the papilla was at right angles to the common duct. The instrument was pushed through the papilla and the sphincter of Oddi cut. When this was done the mouth of the pancreatic duct could be seen opening on the posterior wall of the ampulla 6 mm. above the papilla. A probe could be passed up the pancreatic duct for a distance of 8 cm. The common bile duct and the duodenum were closed and a small drainage tube placed down to that site; this was removed 3 days later. The patient has been asymptomatic since.

Case No. 21—D.R.W. (Beth Israel Hospital, Newark, N. J.—operation with Dr. A. Abrams) was a 40-year-old white male with a 12-year history of attacks of severe epigastric pain radiating to the back and to both upper quadrants, occasionally accompanied by vomiting. The attacks lasted from 2 hours to 2 days and at first occurred about every 6 months, but in the last few years the severe attacks occurred every few weeks and he had pain after eating almost every day. Ten years ago a diagnosis of perforated ulcer was made but no operation was done. Between 1940-1944 he was admitted to 4 different military hospitals. Many roentgenograms showed a normal gallbladder and normal stomach and duodenum. He was finally discharged from the army February 11, 1948 because of incapacitating pain. No diagnosis was made. Examination by a civilian physician revealed calcification of the pancreas (Fig. 36). A cholecystostomy was performed but by request of the patient the pancreas was not removed. He had no pain as long as the cholecystostomy was functioning. As soon as the drainage tube was removed the attacks of pain recurred. A secretin test done on April 12, 1948 revealed marked impairment of the pancreas (total volume 120 cc.; total amylase 65 units). At operation on April 16, 1948 the pancreas was found to be large and very hard with an irregular knobby surface. The gallbladder was removed. A cholangiogram visualized the pancreatic duct only questionably (Fig. 37). The common bile duct was about twice its normal size, and very tortuous, owing to its passage behind the enlarged irregular head of the pancreas. The common duct was opened, the sphincterotome passed into the duodenum and sphincterotomy done. The common duct was sutured and a small drain placed down to the line of suture. He has been asymptomatic since operation.

DISCUSSION

The definitive surgical attack on acute recurrent pancreatitis accepts as its basis that when a common passageway between bile and pancreatic ducts can be demonstrated this anatomic arrangement permits the inception of the disease. It may be possible for other unknown mechanisms, not involving bile in the pancreatic ducts, to cause inflammation of the gland. Pancreatitis occurs in mumps and possibly in other virus diseases. Unaltered bile in the pancreatic duct may be innocuous; the anatomic possibility may be present without reflux ever actually occurring. In this conception, there are these conditions necessary for the occurrence of an attack: a common passageway; bile which has been rendered noxious by concentration of its salts or some other change; and spasm of the sphincter of Oddi.

A common passageway can be demonstrated by operative cholangiography or the presence of pancreatic juice in the gallbladder or common duct. That bile which is concentrated by the gallbladder is a likely chemical agent which is injurious to the pancreas is in part attested by the fact that cholecystectomy is frequently a temporary relieving measure.^{4, 10, 11} The history of patients may reveal a period of freedom from pain after removal of a functioning

gallbladder without stones. Eventually, however, in some of these patients pancreatitis will occur. The sphincter of Oddi is the sealing mechanism which raises the pressure in the common system by recurrent spasm. This spasm can be induced by hydrochloric acid applied to the papilla. As with other muscular elements of the upper gastro-intestinal tract the contraction of the sphincter muscle is also controlled by nervous influences and possibly by hormones. Emotional disturbance or pain can induce spasm. In this sense dysfunction may be related to a similar dysfunction resulting in peptic ulcer or pylorospasm.

An unsolved aspect of this problem is how the bile can enter the pancreatic duct against the secretory pressure of the pancreas itself. Under the stimulus of secretin the flow of pancreatic juice will not permit bile to enter the pancreatic duct. Under the stimulus of ingested food bile pressure and pancreatic juice pressure are the same.

SUMMARY

Methods of diagnosis of recurrent pancreatitis by serum amylase determinations, pancreatic response to secretin stimulation, cholangiograms and biliary tract pressure recordings have been discussed. The etiologic factors first suggested by Archibald of spasm of the sphincter of Oddi in the presence of a common biliary-pancreatic passageway and reflux of bile into the pancreas have been studied on human patients. A summary of patients so studied and treated is presented. These studies confirm Archibald's opinions.

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DISCUSSION.—DR. HENRY DOUBILET, New York: I want to thank the members of the Association for the great honor and privilege of the floor. There are two points I should like to make. One is that this series of patients who have been operated on, forms only a small number of the total patients studied. In all routine biliary tract surgery a cholangiogram is done on the operating table. During this procedure normal tenth hydrocholic acid is applied to the papilla of Vater to produce spasm. These cholangiograms are valuable not only for the detection of common duct stones or malignancy, but also to determine the incidence of a common passageway and a reflux mechanism. A large proportion of these patients have been found to have a common passageway. Three of the patients in whom reflux mechanism was