Resection of Head of Pancreas and Duodenum for Carcinoma—Pancreatoduodenectomy

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Partial or subtotal pancreatectomy has been performed for benign and malignant neoplasms and for hyperinsulinism. In a recent publication, Whipple, Parsons and Mullins have again shown the feasibility of removal of segments of duodenum and portions of the head of the pancreas for carcinoma of the ampulla of Vater or lower portions of the common bile duct. As far as the writer has been able to determine, wide resection of the head of the pancreas together with practically all of the duodenum for carcinoma of the head of the pancreas has not been recorded. Such an operation was recently performed by the author and appears to be a feasible procedure. The history of the patient and details of operative technique are as follows:

H. P., No. 166655, male, age 69 years, was admitted to the medical service (Dr. George F. Dick) January 5, 1937, complaining of more or less constant pain in upper right quadrant of the abdomen radiating through to the back and to the left, of eight weeks' duration, not aggravated by eating, increasing icterus and marked general pruritus of seven weeks' duration, and difficulty in urination, two years. There had not been an appreciable weight loss. Physical examination revealed a thin white male, markedly icteric. A rounded indefinite mass was palpable in the region of the fundus of the gallbladder. Temperature was normal. The Wassermann and Kahn reactions were negative; red blood count, 4.3 million; white blood count, 5,400; hemoglobin, 90 percent. Urinalysis revealed: albumin, negative; sugar, negative; bile, ++ + +; icteric index, 119; the stools were clay colored. Roentgenographic examination of the chest and fluoroscopic examination of the esophagus and stomach were negative; questionable deformity of the duodenal bulb. Cholecystograms were made but the gallbladder could not be visualized after oral administration of dye.

Clinical diagnosis: Carcinoma of the head of the pancreas, with common duct obstruction.

Operation—first stage, January 8, 1937. Spinal anesthesia was used with ethylene toward the end.

In view of the preoperative diagnosis, it was planned to do a cholecystogastrostomy as a palliative procedure. The abdomen was entered through a high midline incision. No excess free fluid was present. Palpation in the region of the head of the pancreas revealed a very firm mass about four centimeters in diameter adherent to the adjacent inner wall of the

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descending portion of the duodenum. Palpation and inspection of the liver showed no evidence of metastases. The gallbladder was markedly distended by bile, its wall was thin, and there were no stones. Palpation and inspection of the peritoneal cavity and the viscera likewise showed no evidence of metastases. A finger could be inserted into the foramen of Winslow. Because the firm head of the pancreas was movable upon the underlying tissues, it was decided to attempt resection of it by a two-stage operation based upon the principles emphasized by Whipple.

At Dr. Phemister’s suggestion the following steps of the first stage were performed: (1) “short loop” posterior gastroenterostomy with two rows of continuous linen sutures; (2) cholecystojunostomy with interrupted silk sutures at a point approximately 12 inches below the above—the loop of jejunum was brought through an opening made in the right portion of the transverse mesocolon, the margins of the rest being sutured to the small bowel passing through it; (3) an enteroenterostomy below the passage of the jejunal loop through the mesocolon. The several procedures are indicated in Fig. 1. It was thus possible for bile to pass into the jejunum and the enteroenterostomy permitted passage of material down the jejunum from the stomach without circulating past the gallbladder. Furthermore, the exposure for the second stage was facilitated by not having the gallbladder anastomosed to the stomach over the region of the pancreas.

Recovery from this operation was uneventful, and the patient was discharged January 27, 1937, for a rest period at home. On February 5, 1937, he was readmitted. The icterus had improved considerably; icteric index, 29. A glucose tolerance test performed on February 8 showed: starving blood sugar, 140 milligrams percent and 291 milligrams percent after three hours, with, + + + reduction of urine. A second test performed a week after the second operation showed starvation blood sugar to be 107 milligrams percent; one-half hour, 183 milligrams percent; two hours, 179 milligrams percent and three hours, 151 milligrams percent. Urine was negative. There is no apparent explanation for the high values obtained in the first test.

Second stage was done February 11, 1937. Under ethylene anesthesia the abdomen was reopened through the old incision. The peritoneal surfaces appeared smooth and glistening but slightly fibrotic. There were no evidences of peritoneal metastases but the lower abdomen was not explored. The liver appeared free from metastases on both inspection and palpation. A curved incision was made through the peritoneum following the right lateral border of the descending portion of the duodenum, and this loop with enclosed head of the pancreas was elevated to the left by gauze dissection. This permitted satisfactory palpation of the lesion which did not appear to have increased appreciably in size since the first operation. It was also possible to ascertain that the growth had not apparently infiltrated into the retroperitoneal tissues.

The stomach at the pyloric sphincter was divided between two clamps, and the first portion of the duodenum was retracted to the right. This exposed the midportion of the common bile duct, which appeared to be about the size of a lead pencil. It was divided between clamps, and the upper end doubly ligated with linen.

The neck of the pancreas was palpated and beneath it a curved grooved director was carefully inserted from above downward and to the left, its tip emerging over the terminal portion of the duodenum. (Fig. 2.) The neck of the pancreas was then divided, the scalpel coming down upon the grooved director. When the parenchyma had been partially severed, several cubic centimeters
of clear, slightly viscous fluid escaped. This was pancreatic secretion dammed up in the dilated pancreatic duct. When division of the neck of the pancreas was completed, it was found that this had occurred just over the superior mesenteric vessels as they coursed downward over the terminal duodenum. The head of the pancreas and adherent duodenum were then retracted downward and to the right and removed after the latter was divided between clamps just beneath the superior mesenteric vein. The pyloric stump of the stomach was invaginated by three layers of interrupted linen sutures, the duodenal stump by two layers of similar sutures. The freshly cut surface of pancreas was ligated by four interrupted and interlocking linen mattress sutures; the pancreatic duct was ligated separately. A large space previously occupied by duodenum and head of pancreas remained. (Fig. 3.) This was drained by a small soft rubber tube and the midline incision closed.

Pathological study. The specimen consists of what appears to be practically the entire duodenum surrounding the head of the pancreas; the latter consisting for the most part of a firm mass that is inseparable from the adjacent duodenal wall. In the fixed (formalin) state the duodenum measures 18 centimeters in length and the head of the pancreas five by four centimeters. The cut surface of the neck of the pancreas does not grossly exhibit tumor tissue. The pancreatic duct is identified, but a probe cannot be passed through it into the duodenum. The severed common duct is identified, and a probe passes readily into the duodenum. The specimen is bisected. The plane of bisection does not include the plane of division of the neck of the pancreas from the body, which was not removed at operation. The carcinoma, arising in the head of the pancreas, has extensively infiltrated the duodenal wall, producing at one point a small ulceration in the duodenal mucosa. The ampulla of Vater is not in-

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**Fig. 1.** First stage. Ca—Cancer in head of pancreas; C.J.—cholecystojejunostomy; H—transverse mesocolon through which loop of jejunum is passed for above anastomosis. G.E.—short loop posterior gastroenterostomy. E.E.—enteroenterostomy. (Figure is diagrammatic, loop of jejunum is not as long as shown; and enterenterostomy was performed near opening in transverse mesocolon.) Fig. 2. Second stage, one month later. Inc.—curved incision through posterior parietal peritoneum along convex border of duodenum permits mobilization of head of pancreas. Division of pylorus. C.—ligated common duct. Curved, grooved director is passed beneath neck of pancreas and over superior mesentric vein (V.) and artery (A.). Neck of pancreas is transected over grooved director. Fig. 3. Termination of operation. The almost complete removal of duodenum and head of pancreas. The stomach and duodenal stump are invaginated, the cut surface of the pancreas ligated with mattress sutures. Dr.—soft rubber drain to large denuded retroperitoneal space. Vein courses upward to join splenic vein, forming the portal vein.
olved in the growth. Two small, firm, discrete lymph nodes are removed from the serosal surface of the third part of the duodenum.

Microscopic examination of a large section through the lesion and adjacent duodenal wall shows a duct cell carcinoma composed of large columnar malignant epithelial cells forming solid cords and tubules. These cell masses can be seen streaming into the duodenal wall between muscle bundles. Sections through the lymph nodes show metastatic carcinoma. Sections through a fragment of pancreas removed from the line of resection show scattered clumps of carcinoma cells. There is also marked fibrosis between clumps of alveoli, diffuse round cell infiltration, and proliferation of small pancreatic ducts.

Postoperative course. Immediate recovery from the second stage was uneventful, there being a minimal temperature reaction and no nausea or vomiting. The small drain was removed on the fifth day. A small amount of clear serous drainage persisted from the drain site in the wound, and on the 14th day it became distinctly biliary in appearance and increased in quantity. The wound otherwise healed per primam. A small Pezzer catheter was inserted into the sinus and connected with a Wangenstein suction apparatus. The daily fluid loss was tabulated and reached a maximum of 560 cubic centimeters on the 44th day after which it decreased rapidly in a few days to approximately 50 cubic centimeters a day and changed from a biliary character to a whitish mucoid discharge containing at intervals recognizable food particles. This fluid was not found to contain active proteolytic enzymes. It was thought at first that the ligated common duct had reopened, but the change in character of the drainage indicated it was an intestinal fistula. Repeated attempts to cause the fistula to heal were made by insertion into it of kaolin and zinc oxide pastes, but these procedures did not entirely succeed although the fistula was reduced to about two millimeters in diameter when the catheter was not in place. Because of difficulty in starting the stream, an indwelling urethral catheter was inserted following the operation. On the 20th day a transurethral prostatic resection was performed by Dr. C. B. Huggins of the Division of Urology, following which practically normal urination was possible.

In spite of the complications noted, the patient’s condition remained generally fair. A full diet was permitted after the 12th day, and although his lack of appetite for sufficient quantities necessitated frequent hypodermoclyses of five percent glucose, adequate amounts of fluid were taken by mouth.

After the third week the patient sat up in bed or got out of bed, walked a little and sat up in a wheel-chair for varying periods, almost every day. The severe pruritus subsided, and the icterus had disappeared by the end of the third week when the icteric index was 13. The stools were always light in color and pasty in consistency but contained bile. This was due to absence of external pancreatic secretion. The urine, tested at intervals, showed no reduction at any time.

On April 26, 1937, the patient’s condition suddenly appeared worse in that there was complete lack of any desire to eat, marked dizziness when he attempted to arise or sit up in bed, and pronounced asthenia. The blood pressure did not fall. The following day the sclera rapidly became yellow, and bile appeared in the urine. There were no chills or rise in temperature. On April 30, 1937, the patient went into a coma and died, this being the 85th day following the second stage of the operation. Urinalysis was negative; blood chlorides, 445 milligrams percent and non-protein nitrogen, 41, all taken shortly before death.
Summary of principal necropsy findings: Carcinomatosis of the peritoneum with ascites (2000 cubic centimeters). Multiple large metastases throughout the liver, a small fistula leading from the inverted duodenal stump (of which section of bowel there remained about 1.5 inches) to the midportion of the healed operative wound. The closed portion of common bile duct contained yellow mucoid material. The site of the duodenum and head of the pancreas contained inspissated material undoubtedly derived from the fistula on the one hand and as a result of injections of kaolin and zinc oxide pastes through the skin opening in an endeavor to close the fistula. However, this space had become much reduced in size as compared to its extent at the second stage of the operation and was well walled off from the general peritoneal cavity. Sections of surrounding granulation tissue showed numerous masses of carcinoma cells. No peritonitis and no inflammation or ulceration in the stomach and intestines were noted. The anastomoses were healed and functioning. Sections of the liver showed moderate polymorphonuclear and round cell infiltration about the small hepatic ducts and scattered small abscesses in the parenchyma. The liver cells exhibited no marked changes in the routine sections or in the sections stained by scharlach-R. No terminal pneumonia was present.

The cause of death was widespread and rapid development of secondary growths in the form of peritoneal carcinomatosis, extensive hepatic metastases and the latter, as well as perhaps the cholectynterostomy, contributing to a diffuse cholangitis. The survival period of almost three months in this case with no obvious marked metabolic disturbances due to the nature of the operation constitutes evidence for the feasibility of this type of operation in dealing with malignant neoplasms such as the one described above.

Total extirpation of the duodenum was for a time thought by physiologists to be incompatible with life. This impression together with the relative infrequency of operable tumors of the duodenum or head of pancreas, and the feeling that total extirpation of the head of the pancreas and duodenum was technically very difficult, no doubt contributed to the general lack of interest on the part of surgeons in these types of operations. However, as long ago as 1918, Lester R. Dragstedt and associates first demonstrated that in the dog the duodenum was not indispensable to life and that this segment of bowel did not have special internal or external secretions necessary for the function of the intestines lower down as was held at that time.

Summary
A case history is presented to show the feasibility of excision of the entire head of the pancreas and practically all of the duodenum for carcinoma of the head of the pancreas. Such an operation might also be performed for primary malignant tumors of the duodenum.

While no gross evidence of metastases was present at the time of the operations, the patient died 85 days following excision and, at necropsy, carcinomatosis of the peritoneal cavity and multiple liver metastases were found. Gross and histological examination of the liver, stomach, and small bowel revealed no evidence that the removal of practically the entire duodenum had resulted in significant metabolic disturbances during the period of survival.

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