

# SPLANCHNIC NERVE SECTION FOR PANCREATIC PAIN

## SECOND REPORT\*

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IN A PREVIOUS COMMUNICATION<sup>1</sup> two of us reported the use of unilateral splanchnicectomy for intractable pain of pancreatic origin. Since this report we have accumulated further experience which has helped to crystallize our indications for operation and the results to be expected from it. The literature has been quoted and discussed in our previous report and only additional data will be considered in this report.

### THE CLINICAL MATERIAL

Seven splanchnicectomies, partly unilateral, partly bilateral, have been done to date for intractable pancreatic pain. A brief summary of their clinical history is as follows:

**Case 1.**—(Previously published.) C. H., hospital No. 108768. A 49-year-old white male was admitted to the Research and Educational Hospital on December 10, 1946, with complaints of pain in the epigastrium radiating posteriorly to the back which had been present for 3 months prior to admission. There had been vomiting shortly after meals for the 10 days prior to admission, shortness of breath, and constipation of 3 months' duration. The pain was described as constant and dull aching, starting in the mid-epigastrium just to the right of the midline and radiating posteriorly to the back in the midline around the level of the lower dorsal vertebrae. There was a weight loss of 15 pounds in 3 months and a marked anorexia. There was no history of clay colored stools or dark urine.

Physical examination revealed a patient of emaciated appearance, chronically ill. Temperature was 97.0° F., pulse 70, respirations 25, and weight was 138 pounds. The heart was normal. There were a few expiratory wheezing râles in the right upper lobe. The abdomen was flat but there was a sense of fullness in the epigastrium, although no definite mass was palpated. The upper abdomen in the mid-epigastrium was moderately tender as were the left hypochondrial and left lumbar areas. Rectal examination was negative. The red cell count was 3,730,000, white blood count 9,800. Serum amylase was 146 on December 21, 1946, 612 on December 30, 1946, and 61 on January 11, 1947. Total proteins were 7.5 per cent, with a serum albumin of 5.5 per cent and a serum globulin of 2.0 per cent. Fasting glucose was 143 mg., nonprotein nitrogen 38, and chlorides 511 mg. per 100 cc. An upper gastro-intestinal roentgenogram and barium enema were reported as normal. Roentgenogram of the chest revealed a circular density to the left upper lobe considered to be a metastatic lesion. Roentgenogram of the dorsal spine was negative. After adequate preparation for surgery, which consisted in part of multiple blood transfusions, the patient was operated upon on January 2, 1947, by Dr. Warren H. Cole. When the peritoneum was opened a

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large tumor mass, occupying the posterior portion of the pancreas and extending upward to the liver edge, was seen. The tumor was estimated to measure 3 by 5 inches. There were no metastases to the liver, although the superior extension of the tumor consisted chiefly of metastatic nodes. In spite of the probable metastasis to the lung, resection appeared indicated, in view of the patient's extreme pain. However, closer inspection of the tumor revealed a superior portion of the mass with its metastatic nodes completely surrounding the celiac axis. The hepatic artery could be felt coming out of the center of the mass. This one point, in addition to the complete incurability, caused the decision against resection to be made, so the abdomen was closed.

In the postoperative period, this patient's pain continued and required large doses of narcotics and sedation for effective relief. However, even heavy doses of narcotics failed to give him adequate relief. For these reasons consideration was given to the possibility of splanchnic nerve block, and perhaps resection of the nerve if indicated by a favorable response to the block. On January 10, 1947, a right paravertebral sympathetic block was done from sixth to the tenth dorsal segment, injecting 10 cc. of 1 per cent procaine at each level. Twenty minutes after the block, the patient stated that the epigastric pain had completely disappeared. For 12 hours after the block there was no return of pain. The patient had not received sedation or narcotics for 8 hours preceding the block.

On January 14, 1947, under intratracheal anesthesia, one of us (G. de T.) performed a resection of the right splanchnic nerve from the level of the diaphragm to the seventh dorsal segment. The sympathetic chain was also excised from above the ninth dorsal to below the twelfth dorsal segment. A small tear was made in the pleura during this dissection, which was closed with interrupted cotton sutures.

Convalescence from this operation was uneventful and there was prompt relief from the epigastric pain. He was discharged from the hospital on January 23, 1947, 9 days after the splanchnicectomy. At the time of discharge he was eating well and had gained several pounds in weight. The relief of pain, however, lasted for only a period of 3 weeks. Deep roentgen-ray therapy to the pancreas was begun on January 31, 1947, and shortly after this the epigastric pain returned. The pain became progressively more severe, and again it was necessary to administer narcotics for efficient relief. The patient refused rehospitalization and became progressively worse. Death occurred on March 4, 1947. Permission for an autopsy was not obtained.

**Case 2.**—(Previously published.) J. A. W., Hospital No. 109477. A 22-year-old white, unmarried female was admitted to the Research and Educational Hospital on December 15, 1946, with complaints of extreme, constant aching pain in the epigastrium radiating to the left flank. She had been well until December, 1945, when she first had noted a dull intermittent pain in the left lumbar area radiating in a radicular fashion to the left hypochondrium. These attacks of pain would occur several times daily and occasionally be associated with vomiting and extreme weakness. She had been hospitalized at another hospital in January, 1946, and we were informed that a left heminephrectomy of the lower pole had been performed at this time, because of a diagnosis of carbuncle of the kidney. The patient remained in the hospital for a period of 5 weeks. The pain persisted after surgery, and 2 weeks following her discharge from the hospital she was readmitted, remaining in the hospital until August, 1946. During this period of hospitalization she had had daily chills with temperature elevations to 104°F. During the second hospital stay, she noted a swelling in the epigastrium; there were intermittent episodes of vomiting, a progressive weakness and weight loss, and a relatively persistent pain in the epigastrium and left lumbar region. After a month of hospitalization, the patient was again discharged. Symptoms persisted, and in March the patient went on an alcoholic bout because of pain. Severe diarrhea developed after 1 week of drinking and this caused the patient to terminate her alcoholism. She was hospitalized

for the third time and a gastro-intestinal roentgen ray series at this time revealed a large mass present posterior to the stomach and displacing this organ anteriorly. This was interpreted as a large pancreatic cyst. The patient was reoperated upon through the old nephrectomy incision, but there were no reported abnormal findings. One week after the operation a roentgenographic study of the gastro-intestinal tract revealed a dramatic reduction in size of the cystic mass. After healing of the lumbar incision, the patient was discharged from the hospital, and stated that she felt somewhat improved, although periodic attacks of pain in the epigastrium and left flank continued to occur. For the 24 hours prior to admission to the Research and Educational Hospital the pain had become severe, and there had been a voluntary dietary restriction, but no vomiting.

On her first admission to this hospital the patient was acutely ill. The temperature was 102°F., respirations 24, and blood pressure 110/60 mm. of mercury. There was a marked dehydration, emaciation, and weakness. The heart and lungs were normal. Diaphragmatic excursions were normal. There was a marked distention of the upper abdomen, especially in the epigastrium, and this portion of the abdomen was rigid. There was also some rigidity of the lower abdomen, but only to a slight degree. The entire upper abdomen was acutely tender. The bowel sounds were active, but not increased. The liver and spleen were not palpable. There was moderate tenderness in the left flank posteriorly. There was no demonstrable fluid wave. Pelvic and rectal examinations were negative. The red blood count was 3,800,000 and the white cells were 28,000. The serum amylase was 42 units. On succeeding days the amylase levels were as follows: December 16, 1946, 23; December 21, 38; December 27, 111; January 4, 1947, 69; January 8, 40; January 11, 43; January 14, 50. The remainder of the blood chemical tests on the day of admission showed: total protein 6.9 per cent with 4.4 per cent serum albumin, and 2.5 per cent serum globulin. Nonprotein nitrogen was 35 mg.; glucose was 68 mg. per 100 cc. of blood.

A flat plate of the abdomen revealed no free air beneath the diaphragm. There were irregular multiple calcareous densities to the left of the first lumbar vertebra, interpreted as pancreatic calculi. An intravenous pyelogram revealed no abnormalities.

A Levine tube was inserted into the stomach and continuous Wangenstein suction was instituted. Intravenous fluids were administered. Penicillin 50,000 units every 3 hours was begun. Under this conservative treatment, there was some slight diminution of the pain during the first 24 hours, but the tenderness and epigastric distention persisted. The white blood count was 28,000 the day of admission and then gradually dropped until the fifth day, when it was 14,300. On the third day there was some lessening of the abdominal distention, and considerably less tenderness. A diagnosis of pancreatic lithiasis and pancreatitis with possible pancreatic cyst was made, and following several blood transfusions and further hydration of the patient, an exploratory laparotomy was performed by Dr. Warren H. Cole on December 31, 1946. When the peritoneal cavity was opened, a large mass was found pushing the stomach anteriorly in the midline. The gallbladder was normal. The mass consisted of the pancreas, enlarged to three or four times its normal size, nodular and very firm. The fact that it displaced the stomach forward had resulted in an erroneous preoperative impression that it was a cyst. The entire pancreas was involved in the process, although the tail was not quite so large. Further exploration of the abdomen was unrevealing, and the wound was closed in layers without drainage. The postoperative course was uneventful. The pain, however, continued and there was severe anorexia with irregular episodes of vomiting, which usually occurred after the intake of even small quantities of food. Parenteral fluid therapy was necessary to maintain the patient's nutritional status at all. Parenteral high vitamin therapy and penicillin were continued, and in addition a course of streptomycin (1 Gm. per day) was given for a 10 day period. Considerable sedation was necessary to control pain at all times. There was some slight improvement

on the fourteenth day after surgery and, at the patient's request she was discharged from the hospital with instructions to return to the outpatient department in 1 week for observation. Readmission to the hospital occurred on January 20, 1947. The patient stated that, since leaving the hospital, she had had almost continuous pain, nausea, vomiting and weight loss, so that on admission she weighed only 78 pounds. Her problem remained the same—continuous narcotic administration was necessary to control pain, amounting to 3 grains of pantopon a day.

Consideration of splanchnic nerve block or resection was suggested to attempt to relieve this pain and accordingly, on January 30, 1947, a dorsal sympathetic block was performed. Ten cubic centimeters of 1 per cent procaine were injected paravertebrally on the left side in each of the segments from the sixth to the tenth dorsal. The block was done in the afternoon, and in the morning preceding the block no sedation or narcotics had been administered. Within 10 minutes after the paravertebral block, the patient reported that there was complete relief of pain, and for the first time in many weeks the patient was comfortable. She slept that night without sedation and felt rested. Because of this result, resection of the left splanchnic nerve was deemed advisable. On February 4, 1947, one of us (G. de T.) performed a left splanchnic nerve resection, including removal of the dorsal sympathetic chain between the ninth and twelfth dorsal. This operation was performed under intratracheal anesthesia. The eleventh rib was resected. Reflection of the pleura revealed considerable inflammatory reaction in the posterior mediastinum. The patient tolerated the surgery very well and her postoperative course was uneventful. There was complete relief of the pain in the epigastrium. Abdominal distention disappeared. There was moderate pain over the thoracotomy incision for several days, but no sedation was required after the second day. The patient began to eat a general diet, and on discharge from the hospital on February 12, 1947, she weighed 82½ pounds. She weighed 107 pounds 2½ months after splanchnic section, a gain of 20 pounds. Relief of pain persisted on re-examination 6 months after operation. Follow-up inquiries after this period were unsuccessful. She appeared once more at the clinic with an acute respiratory infection but could not be hospitalized.

**Case 3.**—Muriel P., hospital No. 111-582, a 43-year-old white female was admitted to the Research and Educational Hospital for the first time on May 15, 1947, complaining of severe persistent pain in the right epigastric region of 18 months' duration. Her surgical history started at the age of 19, at which time an appendectomy and panhysterectomy were done. The hysterectomy was done because "the organs were infected from a previous childbirth." In 1935 she was operated upon for adhesions causing intermittent cramps with nausea and vomiting. The onset of her present illness dated back to February, 1945. At this time she had a sudden series of attacks of hematemesis. Each time, she stated, she vomited about a cupful of bright red blood. Severe, steady, peri-umbilical pain and tarry stools were associated with these attacks. In spite of negative roentgen rays a laparotomy was done at another hospital and her gallbladder was removed. She felt fine until August, 1945, when she was seized with an attack of severe, steady, peri-umbilical pain, nausea and vomiting (greenish-yellow). Gastric suction relieved her and her abdomen was explored again. She was told she had cancer of the liver. She remained at the hospital for about 9 months. During this time she suffered a left hemiplegia, pneumonia and an infection of her left arm. Her weight dropped from 120 to 65 pounds. During the 18 months preceding her admission to the Research and Educational Hospital the pain was of a dull, steady nature with frequent acute severe exacerbations requiring up to 1½ grains of morphine per day. Infrequently the pain radiated to the tip of the right scapula. There was no history of jaundice, clay-colored or fatty stools. She stated that she had always been nervous.

Physical examination revealed a patient who did not appear acutely or chronically ill. Her weight was 126 pounds. TPR were normal. Blood pressure was 118/88 mg. of mercury. Three scars on the abdomen were noted. There was an area of tenderness around the umbilicus. Liver, kidneys and spleen were not palpable. There was an enlarged right inguinal lymph node. Otherwise the examination was negative.

Laboratory examinations revealed a negative urine. The red cell count was 4.5 million with 14 Gm. of hemoglobin. The white cell count was 5,800. The fasting blood sugar was 86 mg. per cent, NPN 28, chlorides 485, serum albumin 5.5, serum globulin 2.5, serum amylase 84. Cephaline flocculation was negative and the thymol turbidity test was 8.0 units. Gastric analysis contained some blood. Total protein was 8.4. Blood Kahn and Wassermann were negative. The colloidal gold was normal.

On May 19, 1947, a flat plate of the abdomen and roentgen ray studies of the dorso-lumbar spine revealed small calcification to the right of the upper lumbar spine which was suspected of lying in the pancreas. Skull films were noncontributory.

On June 12, 1947, the abdomen was reopened, revealing nodules which studded the entire parietal peritoneum. These were most numerous in the pelvis and over the surface of the liver. They were suggestive of a foreign body reaction, perhaps due to talc or sulfa crystals. Biopsy material from the omentum and liver revealed extensive fat necrosis. On these findings the diagnosis of late sequelae following chronic pancreatitis was made.

The postoperative course was uneventful except for the frequent demand for sedatives, narcotics and analgesics. She received 3 dorsal paravertebral procaine injections. Relief of her symptoms would last about 2 days, only to recur and require Demerol and placebos.

On July 15, 1947, the right sympathetic chain was removed from above D10 to below D12. The splanchnic nerve was resected from the mid-thoracic level to the diaphragm. She left the hospital on July 24, 1947, free of symptoms. Follow-up August 1, 1947, revealed slight incisional pain, good appetite and gain of weight. November 6, 1947: No pain, feels excellent and gained 30 pounds. November 11, 1948: Gained another 14 pounds. Complete relief of right sided pain. Had two mild attacks of left subcostal pain. On February 16, 1949, the patient reported by mail that except for an occasional "twitch" in the epigastrium her pain was completely relieved.

**Case 4.**—Alfred K., hospital No. 114-004, a 48-year-old white male, was admitted to the Research and Education Hospital on September 30, 1947, with a three-year history of intermittent epigastric pain, loss of weight and anorexia. A resume of his history reveals that in January, 1944, he noted epigastric distress and occasional pain for the first time. He was treated with diet of milk and cream and aluminum hydroxide. He continued to work until June, 1944, when he experienced a sudden "terrific pain" in the epigastrium. He obtained relief with a hypodermic injection, but a dull ache persisted for 3 or 4 days. Thereafter, fatigue and loss of weight were progressive. In April, 1947, he noted a recurrence of dull epigastric pain. A diagnosis of peptic ulcer was made by roentgen ray. Dietary regimen was tried again but failed to bring relief. By this time complete anorexia was present. Pain was more severe in character especially during exacerbations. He was hospitalized elsewhere, and was unable to eat or drink. He lost 30 pounds over a 2-week period. At this time he gradually became jaundiced and passed clay-colored stools. On May 9, 1947, an abdominal exploration revealed an old perforated peptic ulcer which had penetrated into the pancreas. A gastric resection and cholecystostomy were performed. In 2 weeks the jaundice had cleared and stools returned to normal. Shortly afterward the right upper quadrant pain returned and was severe enough to require hypodermics. He again sought aid and on September 4, 1947, another laparotomy was done at Presbyterian Hospital. The gastro-enteric stoma was adequately patent. The head of the pancreas was enlarged and hard, and there was no free fluid in the peritoneal cavity. A biopsy specimen was taken from the pancreas which showed only a mild fibrosis. A lymph node removed from this area showed no pathologic features. A right celiac ganglionectomy and splanchnicectomy were done. Postoperatively, the old cholecystostomy tract opened and

drained voluminous amounts of bile. Jaundice recurred and stools became acholic. Gradually the icterus cleared and the stools returned to normal color. He was completely relieved of pain for about one week, and the pain recurred in the lower abdomen. Psychiatric consultation confirmed the diagnosis of organic pain. Roentgen rays of his chest and gastro-intestinal tract were negative. Repeated serum amylase determinations were normal.

Admission to the University of Illinois Hospitals revealed a well-developed patient, somewhat emaciated and appearing chronically ill. He weighed about 110 pounds. Temperature 100°F., pulse 104, respirations 18, blood pressure 116/74 mm. of mercury. The sclerae showed no discoloration. A few scattered small lymph nodes were palpable in the cervical region. The heart and lungs were negative. There was a non-draining fistula over the gallbladder area. The abdomen was flat and tense. Liver, kidneys and spleen were not palpably abnormal. Rectal examination was negative. The red cell count was 5.5 million, hemoglobin 12 Gm. per 100 cc., hematocrit 44, white cells 15,400. Prothrombin time was 18 seconds. The urinary specific gravity was 1.026 and the urine contained many red cells with two-plus albumin and bile. Fasting blood sugar was 130, NPN 20, NaCl 446, serum albumin 3.3, globulin 3.2, icteric index 10, amylase 71. Thymol turbidity 7.7 units, cephalin flocculation negative in 48 hours. Stools were of normal size, color and consistency. Serology was negative.

On October 6, 1947, a barium study of the upper intestinal tract showed a normal esophagus and a minimal amount of gastric retention at the end of 5 hours. The gastroenterostomy appeared adequate.

On October 11, 1947, urobilinogen was absent from the stool. Three days later a right dorsal paravertebral procaine injection was done from D9 to D11 with some relief from pain. On October 16, 1947, his stool was not completely acholic but contained an increased amount of fat. On October 18, the icteric index was 11, serum amylase 95. On October 21, 1947, a right dorsal sympathectomy (D9 to below D12) and splanchnic nerve section (D9 to diaphragm) was done. Pain promptly subsided but he continued to have a total biliary fistula. On the second postoperative day he was given 12 tablets of pancreatin 3 times daily.

On November 7, 1947, the abdomen was opened again by Dr. Warren H. Cole. The head of the pancreas contained a hard nodule 5 cm. in diameter. Carcinoma was suspected; however, because of the intermittency of the acholic stools some doubt was entertained as to the malignant character of the lesion. Since the common duct was completely obstructed a cholecysto-jejunostomy was done, using a Roux Y.

On November 12, 1947, the patient became irrational, depressed and unresponsive. This lasted for about 30 minutes. The next 6 days were uneventful, and on November 18, 1947, he had a similar episode from which he did not recover. Permission for autopsy was not granted.

**Case 5.**—Vincent J., St. Luke's Hospital No. 103654, a white male, age 36, was admitted for the first time on December 13, 1947, with a 6-year history of right upper quadrant pain. For the year preceding admission he suffered from intermittent pain in back and right shoulder. At the onset the pain was described as being severe, sharp and radiating across his abdomen. This was accompanied by a severe burning sensation in the epigastrium. Each attack would last anywhere from 5 hours to 5 days, during which time he vomited bile-stained, watery material. The right upper quadrant and back pains were almost constant for about 3 months before admission. He required 100 to 200 mg. of Demerol daily. One month before admission he developed a diarrhea which was light colored and watery. At times, he stated, the stools were white. He lost about 15 pounds in 6 months. There was never any jaundice. On pancreatin for 3 weeks prior to admission.

In 1931 he had an appendectomy, in 1943 a cholecystectomy for lithiasis, and in 1946 an exploratory laparotomy and prolonged common duct drainage. At this time the diagnosis of calcareous pancreatitis was made. Total pancreatectomy was advised, but patient refused this operation.

Physical examination revealed an emaciated man who appeared much older than his stated age of 36. The pupils were pin-point in size, but reacted to light and accommodation. The abdomen was rigid but not tender. No masses were palpable. The liver and spleen were not enlarged. The otherwise negative urine contained 75 mg. albumin. The red cell count was 5 million with 14.6 Gm. hemoglobin; white blood count 8400 with 73 polymorphs and 21 lymphocytes; NPN 24, blood sugar 110, cholesterol 158, chloride 550,  $\text{Co}_2$  65.5 volume per 100, amylase 32, calcium 11.3, Kahn negative, TPR normal,

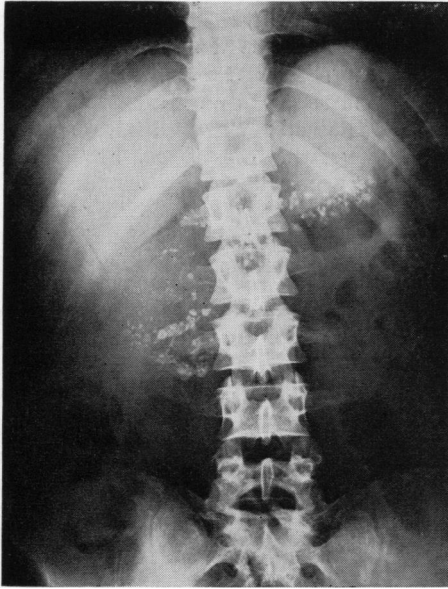


FIG. 1.—Flat plate of the upper abdomen in the case of V. J. (Case 5). Note the massive calcareous deposits, involving the head, body and tail of the pancreas. The head seems to be somewhat enlarged. Patient's pain originally was entirely right-sided, but after relief of this pain by right splanchnicectomy the pain shifted to the left. The X-ray indicates that the entire gland is involved in the calcareous process. The deposits disappeared from the head after prolonged pancreatic drainage.

blood pressure 153/90 mm. of mercury. Flat plate of the abdomen showed massive calcium deposits involving most of the pancreas (Fig. 1). On two occasions when he suffered severe pain, a right dorsal paravertebral procaine injection from D6 to D10 brought relief. During the first 5 days of hospitalization he required daily 400 mg. of Demerol, occasionally morphine gr.  $\frac{1}{4}$  and barbiturates.

On December 19, 1947, a right dorsal sympathectomy and splanchnic section were done from D9 to the diaphragm. His postoperative course was uneventful except for a complaint of suprapubic and testicular pain. Urine studies and intravenous pyelogram were negative. Glucose tolerance December 24, 1947, was 101, 235, 243, 101 mg. per 100. During the first week after surgery he only required 1 or 2 narcotic administrations. Thereafter a barbiturate at bedtime was all he asked for. He left the hospital on December 31, 1947, greatly relieved.

His second admission was on March 7, 1948. He stated that one month after leaving the hospital, he noticed a hard, tender mass in the right upper abdomen, which varied in size from day to day. He also complained of sharp, gaslike pains in the left upper abdomen. He gained 15 pounds. There was no jaundice and his stools were inclined to be soft and light colored. He averaged 2 stools a day and was taking 2 tablets of pancreatin 3 times daily. He again started taking narcotics.

Physical examination revealed the presence of a large grapefruit sized mass in the right upper quadrant with no jaundice. Laboratory examinations differed from the previous reports in so far as the intravenous glucose tolerance test which had greatly improved showed 92, 154, 142, 117, 105 mg. per 100. Flat plate of the abdomen revealed a pancreatic retention cyst.

On March 17, 1948, the abdomen was reopened and the cyst was drained and marsupialized by Dr. John T. Reynolds. The cavity of the cyst contained many stones, some adherent to the cyst wall. Enzyme studies of the pancreatic and duodenal secretions were made. Whereas there was no amylase activity in the duodenal fluid, the pancreatic fluid amylase activity rose to 2048 units. Twenty cubic centimeters of pancreatic fluid mixed with 700 mg. of washed out rat intestine produced almost complete digestion of the intestine in 24 hours. A similar test with duodenal secretion had no effect on the rat intestine. The average measured 24 hour output of pancreatic fluid ranged between 800

to 1000 cc. By the fifth postoperative day, codeine gr.  $\frac{1}{2}$ , aspirin gr. 10 once daily were all the analgesics he required. He was discharged April 1, 1948.

He was readmitted July 5, 1948, for evaluation of pancreatic fistula. Since the previous admission he had gained 20 lbs. and had no pain. He discontinued pancreatin, and his stools were copious, fatty and foul. On several occasions small stones were extruded from the fistula. Physical examination revealed only a pancreatic fistula. Glucose tolerance was 97, 134, 105, 100, 98 mg. per 100. Insulin tolerance was 100, 94, 72, 69, 101, 97 mg. per 100 of sugar in the blood. There was essentially no change in enzyme activity. Lipiodol study of the fistula showed opaque material extending toward the upper quadrant in a linear manner. On July 16, 1948, a left dorsal sympathectomy and splanchnic nerve section were done from the ninth dorsal segment to the diaphragm. Insulin tolerance 89, 69, 74, 69, 76, 86, and pancreatic enzyme activity remained unchanged. Pancreatic output was not measured. He was discharged July 26, 1948. When last heard of, he complained of mid-epigastric pain at the site of the external pancreatic fistula.\*

**Case 6.**—Richard D., University of Illinois Clinic No. 340-977, a 33-year-old white tavern keeper was well until 1945, when he began to complain of epigastric pain which radiated through to the back. These pains came in a series of attacks generally about an hour after eating. The pain was quite severe and on occasion necessitated hypodermics for relief. He had no jaundice or clay-colored stools until an attack in 1947. At that time a celiotomy was performed at an outside hospital where a diagnosis of chronic pancreatitis with obstruction of the common duct was made. A cholecystogastrostomy was performed with relief of the jaundice; however, foul bulky stools, which had been present preoperatively, persisted. The pain which he had experienced was not relieved by the operative procedure, and he was controlled only with narcotics until August 1948, when he reported to another institution for examination. There a right splanchnic nerve section was performed with relief of the pain for about one month. The pain, however, recurred in approximately the same position on the opposite side and the midline, except that it did not radiate through his back. He also experienced episodes of nausea and vomiting accompanying these attacks of pain. He was admitted to the hospital for these symptoms. A light spinal anesthesia was performed during an attack while in the hospital, with complete relief of his symptoms. Roentgen ray examinations revealed numerous small areas of calcification in the region of the pancreas, which was considered consistent with a chronic pancreatitis. An upper gastro-intestinal series was essentially normal. Urinalysis showed no glucose or albumin. Hemoglobin 13.5 Gm.; hematocrit 44, red blood count 4,800,000, NPN 33,  $\text{CO}_2$  58, NaCl 511, total protein 6.1 with albumin 4.5, globulin 1.6, serum amylase 65 and 88, glucose 139 mg. per 100. Physical examination revealed some tenderness in the upper abdomen without spasm, rigidity or palpable masses during an attack. The tenderness was fairly well localized in the epigastrium. The examination was otherwise normal. On January 4, 1949, a left dorsal sympathectomy, removing the ganglia from the ninth through the twelfth dorsal segment as well as the major splanchnic nerve, was performed. Postoperatively, the patient did well and had complete relief of his preoperative pain, nausea and vomiting. He developed pain in his incision, however, which caused moderate discomfort. Routine urinalysis, following surgery, revealed 4-plus glycosuria; fasting glucose was repeated and was found to be 235 mg. per 100. On January 10, a glucose tolerance test (intravenous) gave the following: fasting, 190, 320, 286, 267, 229. On January 12, a glucose tolerance test gave the following: 229, 308, 267, 276, 258. Postoperatively, his serum amylase was slightly elevated, being 148 on the 6th, 213 on the 8th, and 189 on the 11th of January. The icteric index, serum bilirubin were normal. He also continued to have fairly large bulky stools. He was transferred to the medical service on the tenth postoperative day for management of his diabetes and apparent steatorrhea. At this time he was asymptomatic except for slight pain in his incision. On

\* The fistula was implanted into the bowel in October, 1949, by Dr. J. T. Reynolds. He complained of no pain. The calcareous deposits had disappeared from the right side of the pancreas.



the medical floor his diabetes has been well controlled with 14 units of regular insulin and 10 units of protamine insulin each day. He was placed on a 2500 and 44-calory diet, which is considered basal plus 60; and the diet contained 284.6 Gm. of glucose. It is interesting to note that he has occasionally been home on pass from the medical service and during those periods has developed mild exacerbation of his nausea and vomiting without pain. When last examined, his abdominal pain had completely disappeared, and he had put on 10 pounds. Diabetes seemed stable but persistent.

**Case 7.**—This additional case has been brought to our attention by Dr. O. C. Julian, who supplied the following abstract from the Vascular Surgery Unit at Hines Hospital, Illinois: R. B. H., No. 220146, a 34-year-old accountant, had attacks of vague epigastric distress at the rate of about three a year, beginning in 1939. He sought medical advice in 1945 because these attacks had become more frequent and a continuous pain had been added. This continuous pain was in the right side of the epigastrium. It was dull in character and was distinctly aggravated by eating. The attacks of vague epigastric distress changed in character late in 1946. At this time they occurred weekly, lasting two or three days each time, and were characterized by paroxysms of colicky epigastric pain radiating to the right upper back and accompanied by nausea and vomiting. In 1948 pancreatic stones were found on roentgen ray. The patient was placed on pancreatin without improvement. There were no foamy or fatty stools at any time. He lost 32 pounds of weight. He was first seen in the Vascular Clinic in December, 1948, and gave the foregoing history.

Physical examination was essentially negative except for evidences of marked weight loss which the patient ascribed to his avoidance of eating because eating produced pain. There were no tender areas or masses within the abdomen. He required  $\frac{1}{4}$  gr. of morphine 3 times a week. A splanchnic procaine block was done. The patient had immediate relief of the pain, lasting two and one-half hours. During the ensuing two weeks the symptoms returned and for this reason a right splanchnic section and excision of the tenth, eleventh, and twelfth dorsal ganglia was done on December 20, 1948.

The last follow-up examination was about March 1, 1949. The patient stated that since operation he had been relieved of all pain. His appetite had returned and he had gained 13 pounds. In the week before this examination he had started to have a little ache in the left side of the epigastrium, which had completely disappeared.

#### DISCUSSION

After our initial experience with Case 1, in which pain of pancreatic origin was due to cancer, we have purposely refrained from advocating or performing splanchnicectomy for carcinoma of the pancreas, since in addition to the visceral pain, mediated by the splanchnic nerves, the invasive lesion affects the peritoneum, the lumbar roots and their outflow, and thus pain-relief will be very temporary. Nevertheless, because of the uncertainty in Case 4, in which two experienced abdominal surgeons could not make a positive diagnosis of cancer, and in whom a histologic diagnosis of chronic fibrosing pancreatitis was obtained, another instance of pancreatic cancer was subjected to splanchnicectomy. Since the patient died shortly after a cholecysto-jejunostomy, this case must be excluded from the analysis of our results, which thus must be based on five patients suffering from chronic pancreatitis with intractable pain, necessitating increasing doses of narcotics. (Table I.)

Martin and Canseco<sup>2</sup> have made the point that surgical treatment offers the only means of relief. It is true that pancreatic extract by mouth is useful

for the diarrhea, and that a diminished sugar tolerance, or frank pancreatic diabetes as seen in our cases, need attention, but the inability to eat, the frequent bouts of vomiting due to reflex pylorospasm,<sup>3</sup> produce a severe weight loss and the increasing intake of narcotics brings on addiction. For this reason, when the diagnosis of chronic sclerosing calcareous pancreatitis is made, early surgical relief from pain is advisable.

In the group reported by Martin and Canseco from Johns Hopkins University, five surgical methods were employed, namely: partial pancreatectomy,<sup>4</sup>

TABLE I.—*Splanchnic Nerve Section for Chronic Pancreatitis*

Case	Age	Weight Loss in Pounds	Daily Nar- cotic Intake	Splanchnic- ectomy	Pain Relief	Gain in Weight (Pounds)
J.A.W.	22	25	Pantopon gr. 3	Left	Complete 2 years	20
M.P.	43	55	Morphine gr. 1½	Right	Complete* 19 months	35
V.J.	36	15	Demerol 700 mg.	Bilateral	Complete†	18
R.D.	33	15	Demerol 300 mg.	Bilateral	Complete 6 months	10
R.B.	34	32	Morphine gr. ¼‡	Right	Complete 2½ months	13

\* Two attacks of left-sided pain.  
† One attack due to pancreatic retention cyst, 14 months.  
‡ Three times a week.

total pancreatectomy,<sup>5</sup> complete pancreatic denervation by sectioning both vagal and sympathetic fibers,<sup>6</sup> pancreatotomy with removal of stone,<sup>7</sup> and ligation of pancreatic ducts, which was their choice. In a case of chronic calcareous pancreatitis both the ducts of Santorini and Wirsung were tied off, but during the course of exploration numerous calculi were removed and release of pancreatic fluid was obtained which may have contributed to the relief of pain.

An analysis of the mortality and morbidity of total pancreatectomy would not seem to warrant its employment in benign lesions. Partial pancreatectomy, particularly left-sided pancreatectomy, is a far more benign procedure. It has been employed by Mallet-Guy ever since 1935, who described 34 cases in his monograph.<sup>8</sup> Mallet-Guy felt that biliary drainage was useful in diffuse pancreatitis or in cases limited to the head of the pancreas. However, biliary infection and drainage did not seem to affect the tail of the pancreas, which he removed in five instances with four cures lasting for several years and one postoperative death. The same author, however, became impressed with the relief of left-sided splanchnic nerve sections, particularly in those cases where the sclerosing or calcareous lesion was not limited to the left side, and in a recent communication<sup>9</sup> reported on 70 left splanchnicectomies for chronic relapsing pancreatitis done from the year of 1942 to 1948. These were done below the diaphragm, with a subperitoneal lumbar approach and

with one death. Of 37 patients, whose follow-ups extended from one to seven years, there were five failures, 21 excellent, seven very good and three good results. One patient died. The failures were mostly due to a hyper-tonus of the biliary tract, which should be drained externally or internally when compression or stenosis is demonstrable. He would only perform partial pancreatectomy now in case of failure of splanchnicectomy. One patient had a bilateral splanchnic section when the pain shifted to the right.

Our five cases of the benign, chronic relapsing variety allow some speculation as to the mechanism of relief obtained. In Case 2 it was most striking to see the immediate subsidence of persistent vomiting and upper abdominal distention. The arguments for the splanchnic nerves being the exclusive sensory afferents of the upper abdominal organs need not be repeated here.<sup>1</sup> Their interruption also explains the abolition of viscerovagal reflexes leading to biliary and pyloric spasms, which have been studied in connection with pulmonary embolism.<sup>10</sup> Some authors, however, have expressed the opinion that an efferent, vasodilator effect may be beneficial on the vasoconstriction and edema which is an accompaniment of the acute or recurrent attack. Popper,<sup>11</sup> Marion<sup>12</sup> and Gage<sup>13</sup> have seen acute attacks of pancreatitis subside after paravertebral or splanchnic block. MacKenzie and one of us,<sup>14</sup> writing in 1932 on acute pancreatic necrosis, made the point that edema may proceed into hemorrhage or necrosis, and this has been confirmed experimentally by Popper and Necheles.<sup>15</sup> They produced extensive pancreatic edema by ligation of the pancreatic duct and subsequent stimulation of pancreatic secretion by secretin. This edema can progress into necrosis. Such findings would make it doubtful that ligation of the pancreatic duct as advocated by Martin and Canseco<sup>2</sup> should be done for the relief of pancreatic pain, since it might activate an acute process, especially if pancreatic drainage is not available through pancreatotomy. But it might also explain a rapid alleviation of symptoms after sympathetic block if the edema has not progressed to extensive destruction.

One can block the paravertebral segments from the sixth to tenth dorsal level on the side of pain and obtain temporary relief. This was done as part of the preoperative study.

Interestingly, the fluctuating amylase values, which might be interpreted as symptoms of increasing and decreasing pancreatic inflammation, stabilized after splanchnic nerve section in Case 2. In Case 6 there seemed to be an exacerbation of the inflammatory process after splanchnicectomy, manifested by rising amylase values and a deterioration of sugar tolerance. Unfortunately, in this patient no preoperative sugar tolerances are available; however, his high tolerance curve may have a hepatic component because of his excessive alcoholic intake.

Gage<sup>13</sup> suggested that sympathetic interruption relieves ductal and vascular spasm in the pancreas. That this may well be a factor is illustrated by a cholecystogram of Lena S., a patient whose history was described in our

first communication<sup>1</sup> and whose painful biliary colics became painless after bilateral splanchnicectomy undertaken for the relief of hypertension. The reflux of the dye into the pancreatic duct is very evident in this case. (Fig. 2.)

Mallet-Guy has emphasized in his writings,<sup>4, 8, 9</sup> that the inflammatory sclerosis with its sensory nerve irritation sets up a reflex pain and spasm not unlike a causalgic state, and one of us has expressed the same idea in relation to certain post-cholecystectomy syndromes.<sup>16</sup> Experimentally, Mallet-Guy produced pancreatic edema by stimulating the left splanchnic nerve with a weak current.<sup>17</sup> While these various mechanisms may be all at play, the instant pain relief following procaine block or surgical section of the appropriate sympathetic pathways is an established fact in visceral pain of pancreatic origin.

While chronic pancreatitis may involve isolated segments of the gland, and thus permit a partial excision or unilateral splanchnicectomy, a follow-up of our patients would indicate that bilateral denervation may become necessary when the pain shifts over to the unoperated side. This is a thought expressed to us by Dr. James C. White<sup>18</sup> and is analogous to the situation encountered in angina pectoris, when unilateral sympathetic denervation almost invariably has to be followed by operation on the opposite side.

Since splanchnicectomy on the right side increases biliary motility and since this may result in distention or pancreatic reflux in cases of common duct compression or stricture, it is possible, as Mallet-Guy points out, that the biliary tract should be decompressed prior to splanchnicectomy when a hypertonus exists. In the case of Vincent J. (Case 5), a huge pancreatic cyst had to be opened and marsupialized after splanchnic section, and while the mass in the head of the pancreas was present before operation, it seemed to grow rapidly afterwards. Since biliary reflux into the pancreas—when the anatomic conditions are suitable—is one of the factors in the production of pancreatic edema and necrosis, one wonders whether splanchnicectomy or splanchnic block, while it relieves pain and abolishes visceral reflexes, may not

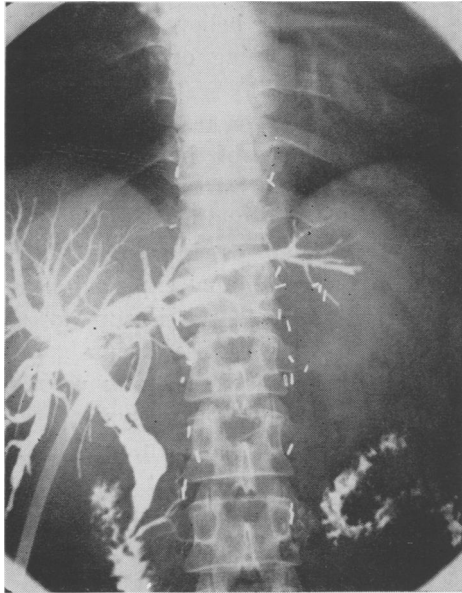


FIG. 2.—Visualization of the biliary tract in the case of L. S. through the common duct. This patient had a painless obstructive jaundice following a dorso-lumbar sympathectomy and splanchnic nerve section. Note the metal clips along both sides of the spine. Note the reflux into the pancreatic duct, which occurs in about 20 per cent of the cases.

favor more biliary reflux. With pancreatic ducts obstructed by stone or inflammation, this possibility is not too great but cholecystograms and visualization of the biliary tree with pressure-measurements may call for internal biliary drainage before splanchnicectomy.<sup>8</sup>

Bilateral splanchnicectomy is a benign procedure. It carries about one per cent mortality in our hypertensive series of 400 patients. It is to be preferred to partial and total pancreatectomy, and to pancreatotomy and to duct-ligation. We believe that it will assume a standard place in the treatment of chronic sclerosing or calcareous pancreatitis accompanied by intractable pain.

Recently, Grimson, Hesser and Kitchin<sup>19</sup> reported the removal of both celiac ganglia and of the superior mesenteric ganglion in a 33-year-old man suffering from calcareous pancreatitis. Following this operation pain was relieved for five months but recurred with severe attacks of back-pain and one attack of epigastric pain. This operation has the obvious advantage of allowing for abdominal exploration and section of visceral pain fibers at the same time. Whether it is superior to bilateral splanchnic nerve section remains to be seen. It seems probable that with a recent tendency to return to the abdomen from thoracic neurectomies (as in vagotomy for duodenal ulcer, sympathectomy for hypertension) more visceral neurectomies will be done through the abdomen, and this is what Mallet-Guy has advocated for pancreatitis. Our present experiences would favor a thorough abdominal exploration, a biliary side-tracking operation if necessary, and a retropleural section of visceral afferent fibers at a later date.\*

#### SUMMARY

Seven patients are being reported in this series who underwent splanchnicectomy for pain of pancreatic origin. Of them two were suffering from inoperable carcinoma of the pancreas, and such patients do not obtain anything but temporary relief from the operation. The remaining five patients suffered from chronic calcareous pancreatitis and their response to the operation, as manifested by relief of pain and gain in weight, was excellent. Two out of four patients had bilateral splanchnicectomies and it seems likely that a certain group of patients, whose pancreatic involvement is diffuse, may have the second splanchnic nerve cut after the pain subsides and shifts from the dominant to the silent side. The state of the biliary tract should also be considered, since biliary reflux into the pancreas may occur under certain conditions. The operation done in these patients was a retropleural supra-diaphragmatic splanchnic nerve section and excision of the dorsal sympathetic chain from the ninth to the twelfth dorsal segments.

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\* Since this article was submitted for publication, Ray and Console (*Surg., Gynec. and Obst.*, **89**: 1, 1949) have reported conclusions identical with ours.

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