

LIGATION OF THE SPLENIC ARTERY, THE OPERATION OF CHOICE IN SELECTED CASES OF PORTAL HYPERTENSION AND BANTI'S SYNDROME*

ALEXANDER W. BLAIN, M.D. AND ALEXANDER BLAIN, III, M.D.

DETROIT, MICHIGAN

FROM THE DEPARTMENT OF SURGERY, ALEXANDER BLAIN HOSPITAL AND CLINIC

A TREMENDOUS AMOUNT of progress has been made in both the operative attack on portal hypertension and in the excision of large adherent spleens since the senior author reported the first ligation of the splenic artery for Banti's syndrome in 1918.¹ Whipple,² Blakemore³ and Blalock⁴ have developed the technic of portal-caval anastomosis to the point where this is the operation of choice in most cases of portal hypertension. The technical problems involved in doing a splenectomy for the large adherent spleens seen in Banti's syndrome have been greatly reduced by improvements in anesthesia, pre- and postoperative care with blood replacement, early ambulation and newer suture materials. One of the greatest advances in surgery of the spleen has been the employment of the combined thoraco-abdominal approach popularized by Carter.⁵

Ligation of the splenic artery, while admittedly a less radical and less effective procedure than shunting operations, remains, in our opinion, the operation of choice in selected poor risk patients with portal hypertension and congestive or primary splenomegaly, and we offer it as a procedure of considerable merit in appropriate circumstances. Everson and Cole⁶ have recently brought this operation to the attention of the surgical profession by reporting good results in two of three poor risk patients with portal hypertension. It was their opinion that these patients would not have tolerated more extensive operative procedures. Recently in a progress report of the patient operated upon for Banti's syndrome 34 years ago,⁷ it was mentioned that the operation had recently been performed in other patients. Sufficient time has now elapsed to evaluate the results in three patients operated upon in 1947. The fifth case in this series was operated upon January, 1949. Further time will be necessary to secure the final results in this series.

Prior to reporting the cases mentioned, the effect of ligation of the splenic artery in animal experiments and the technic of operation in patients will be discussed. The results obtained in the first patient with Banti's syndrome operated upon in 1913 will be reviewed.

LIGATION OF SPLENIC ARTERY IN DOGS

Experiments carried out a number of years ago¹ may be summarized thus: When the splenic artery is ligated in dogs, there is an immediate shrinkage

* Submitted for publication December, 1948.

of the spleen pulp. If the splenic vein is ligated with the artery left patent, there is a swelling of the spleen to nearly twice its size and weight. Ligation of either the splenic artery or the splenic vein in the dog, under sterile conditions, can be done without mortality. At a second operation in the experimental animals mentioned above (arterial ligation) the spleen was found to be atrophied and wrapped in omentum. There was no necrosis.

TECHNIC OF SPLENIC ARTERY LIGATION

The technic of splenic artery ligation is usually fairly simple. The vessel can be isolated by opening into the lesser peritoneal cavity through an incision made in the gastro-colic omentum. The vessel, as it runs along the superior border of the pancreas is well visualized as are the tail of the pancreas and the splenic hilus. The vessel is easily palpated and can be isolated from the vein without tearing the vein. Care must be used not to injure the pancreas. The artery is then severed between silk ligatures (two on both proximal and distal stumps). We usually ligate the vessel above the pancreas if it is not too deeply imbedded in the pancreas. Alternative sites have been at a point just distal to the tail of the pancreas and at a point just distal to the origin of the splenic artery, from the celiac artery. To ligate the artery at this last site, the stomach is reflected upward after detaching the gastro-colic omentum. In only one patient in our experience, to be mentioned later, did all three sites prove so inaccessible that splenectomy was the only alternative. The gastro-colic omentum is closed with interrupted silk sutures and the abdomen closed. We now prefer the use of a left upper quadrant transverse incision and the use of steel wire sutures to close the abdomen.

REPORT OF CASES

Case 1.—On March 15, 1913, a 38-year-old Greek laborer was seen because of pain in the left upper quadrant and a mass in this region. He had been short of breath, weak, and unable to work for the preceding two months. The tumor in the left upper quadrant had been present, to the patient's knowledge, since 1894. It had been growing progressively larger.

Physical examination revealed a large tumor filling the whole left upper quadrant and extending about 3 inches below the umbilicus. The splenic notch could be felt very plainly and left little doubt as to the organ involved. The liver was slightly enlarged. The blood examination showed: erythrocytes, 3,840,000; leukocytes, 5,555; polymorphonuclears, 58; large lymphocytes, 5; small lymphocytes, 35.5 and eosinophiles, 1.5. The hemoglobin was 70 per cent. No plasmodia were found. A diagnosis of Banti's syndrome was made and splenectomy was decided upon.

On March 25, 1913, under ether anesthesia, a 13 cm. long left rectus incision was made. There was a moderate amount of free peritoneal fluid. The liver was found to be slightly enlarged. The spleen was enormous and was free on its anterior surface. However, it was firmly bound, posteriorly and superiorly, to the diaphragm by very vascular adhesions. The veins from the spleen were markedly dilated and extremely thin. After attempting to divide some of the vascular adhesions, splenectomy was considered too hazardous and a decision was made to ligate the splenic artery. The artery was isolated about 3 cm. from the spleen, clamped, and tied with chromic catgut in two places. There

was an immediate shrinking of the spleen to about one-fourth its former size. The wound was closed without drainage.

Except for a fever on the first 2 postoperative days, the patient made an uneventful recovery and was discharged on the seventeenth postoperative day. On April 20, 1913, the patient's hemoglobin had risen to 90 per cent. A painful bulge was present in the center of the wound which, when opened with a hemostat, exuded a large amount of broken down splenic tissue. He promptly returned to work.

Over the years the senior author has kept in touch with the patient reported in 1918. The man returned to Greece and settled in Athens. In February, 1947, a letter was received from a mutual friend who stated that he had visited the patient and found him in good health. Thus, 34 years after ligation of his splenic artery for splenomegaly, he was well and had not developed ascites.

Case 2.—(A. B. H. No. H-1607) A 54-year-old white female was seen at the Clinic on April 25, 1947, complaining of anorexia, fatigue, constipation, and weight loss of 35 lbs. during the previous 4 months. For the past month she had been jaundiced. Examination revealed a jaundiced white woman of the stated age with a large palpable mass in the left upper quadrant and evidence of arteriosclerotic heart disease with slight edema of the ankles. There was no ascites or prominence of superficial abdominal veins. The liver was not palpable. Roentgen ray studies showed a small hiatal hernia at the cardia of the stomach, normal small intestine and colon and a non-functioning gallbladder. She was markedly anemic, her hemoglobin being 33 per cent, (1,610,000 RBC). Careful blood studies failed to reveal the presence of spherocytes. The icterus index was 62.8 and no urobilinogen was found in the urine. By means of multiple blood transfusions, she was prepared for operation, and on May 28, a laparotomy was performed.

At operation, the spleen was found to be three times the normal size and the liver appeared to be normal and free of any gross evidence of cirrhosis. No biopsy was taken. The gallbladder was bound by multiple adhesions and contained stones. No stones were palpated in the cystic or common ducts. Because of the condition of the patient and the numerous adhesions about the enlarged spleen, splenic artery ligation was carried out in preference to splenectomy. The artery was approached through the lesser sac via an incision in the gastro-colic omentum. It was freed from the superior border of the pancreas, isolated, ligated with silk sutures and severed. The gallbladder was not removed in spite of the presence of stones because the patient's condition was not deemed sufficiently satisfactory for further operative procedure.

Following the operation, she made an uneventful recovery and remained free of all her preoperative symptoms for 12 months. There was no evidence clinically of necrosis of the spleen. The spleen became no longer palpable presumably due to atrophy. In May of 1948, episodes of jaundice began to recur. Further operative intervention has been advised.

Case 3.—(A. B. H. No. G-3455) A 49-year-old Greek male was first seen at the Clinic on September 30, 1946, complaining of gradual enlargement of the abdomen, swelling of both legs and weakness, weight loss, nausea and vomiting of 6 months duration. He had imbibed large quantities of alcohol for many years. A diagnosis of cirrhosis of the liver was made and several paracenteses were performed prior to ligation of the splenic artery on May 28, 1947. The spleen was greatly enlarged. His postoperative course was uneventful and when last seen in June, 1949 (over 2 years postoperative) he was healthy, working daily and drinking a pint of wine daily. There has never been any hematemesis either before or after operation.

Case 4.—(A. B. H. No. G-2318) A 50-year-old male was first examined at the Clinic on May 27, 1946. He complained of swelling of the abdomen and legs, indigestion and chest pains of a year's duration. The diagnosis of cirrhosis of the liver was confirmed

by peritoneoscopy June 7, 1946. At operation, the spleen was about four times its normal size. Numerous paracenteses were performed prior to transfer to the surgical department and ligation of the splenic artery on June 3, 1947. The patient's postoperative course was not remarkable and he did well until his ascites began to re-accumulate about 7 weeks postoperatively. He refused further paracenteses. On September 8 (four months after operation), he choked while eating breakfast and was in coma when seen a few hours later. He was slightly jaundiced. He expired the following day.

Case 5.—(A. B. H. No. 48-3784) A 51-year-old male from Armada, Michigan, referred by Dr. John R. Boland, January 10, 1949, because of an episode of massive hematemesis 6 weeks previously which had required 4 blood transfusions. He had had no other gastro-intestinal symptoms, but stated that he had noted edema of the ankles during the last 2 months. He had been drinking alcoholic beverages heavily for the past 6 years. He had ascites with shifting dullness and a fluid wave. The liver was enlarged, its border being palpable 5 fingerbreadths below the right costal margin. There was also splenomegaly and the splenic border was palpable 5 fingerbreadths below the left costal margin. There was cheilosis and slight gynecomastia. Roentgen ray studies revealed the presence of esophageal varices, moderate gastritis with probable ulcer deformity of the duodenal bulb and the presence of gallstones.

His hemoglobin on admission was 10 Gm. per 100 ml. blood. There were 7,100 white cells of which 76 per cent were polymorphonuclear leukocytes and 22 per cent lymphocytes. Urinalysis revealed no abnormalities. The icteric index was 9.2 units. A bromsulphalein test showed 30 per cent retention of dye in 15 minutes and 10 per cent retention of dye in 45 minutes. Total serum protein was 6.0 Gm. per 100 cc.; albumin, 3.7 Gm. per 100 cc.; and globulin, 2.3 Gm. per 100 cc. Prothrombin time was measured as 32 per cent of normal. The cephalin flocculation test showed a trace of flocculation in 48 hours.

A diagnosis of Laennec's cirrhosis with portal hypertension and Banti's syndrome was made. Because of the ascites and the episode of massive hematemesis, operation was carried out on January 18, 1949 (A. B. III).

Through a left upper quadrant transverse incision, the abdomen was opened revealing a tremendously enlarged liver and spleen. The omentum was plastered to the diaphragm and over the liver and spleen ("a natural omentopexy"). This omentum contained numerous large dilated veins. The spleen was fixed to the diaphragm and lateral parietal wall by means of numerous very vascular adhesions. It was possible by careful dissection to approach the pancreas through the gastro-colic omentum. After good exposure of the pancreas was obtained, the splenic artery could be palpated running along its superior border. This artery was very tortuous and a thrill could be palpated all along its course and distal to the tail of the pancreas. The splenic vein was also palpable. An incision was made in the peritoneum over the point on the superior border of the pancreas where the splenic artery pulsations could be best palpated. This incision was carried through about 1 cm. of pancreatic parenchyma, exposing the splenic artery which was doubly ligated with heavy silk ties. This large vessel was not severed. The opening in the gastro-colic omentum was closed and then the abdominal incision was closed using wire sutures throughout, and the patient returned to his room in good postoperative condition.

He made an uneventful recovery and was discharged home on the tenth postoperative day. Some 10 months later, in spite of his refusal to discontinue drinking, there has been no further episode of hematemesis and no recurrence of his ascites or edema of the ankles.

DISCUSSION

It is believed that the splenic vein contributes about 40 per cent of the blood entering the portal vein. When the spleen is enlarged, this percentage is

increased. The other 60 per cent comes from the superior mesenteric vein. By ligating the splenic artery, this 40 per cent or more of portal blood flow should be eliminated and a consequent reduction in portal hypertension expected. Indeed, this operation should reduce portal hypertension more than splenectomy because the veins carrying blood for the portal system around the portal bed block via the spleen and its vascular attachments are left intact, whereas in splenectomy they are removed.

Inasmuch as splenectomy in the presence of portal hypertension is an operation of some magnitude, and inasmuch as splenic artery ligation produces a functional splenectomy without always destroying venous anastomotic channels, the advantages of the latter procedure can readily be appreciated. Furthermore, Blakemore has stressed that splenectomy should not be done unless the operator is prepared at operation to do a spleno-renal anastomosis. Once splenectomy has been done, the difficulties in performing a subsequent shunting operation are often almost insurmountable. Previous splenic artery ligation would probably not make a shunting operation as difficult to do if the patient's improvement would allow such an operation at a later date.

In various splenopathies, other than that due to portal hypertension, there are a group of cases in which splenic artery ligation would seem to be the operation of choice. In Banti's syndrome (unassociated with cirrhosis of the liver) where a tremendously enlarged spleen is firmly adherent to adjacent viscera with markedly vascular and friable adhesions, and where the patient's condition is precarious enough to preclude an operation of the magnitude of splenectomy, ligation of the splenic artery is obviously safer than splenectomy. One of us (A. B. III) has had the opportunity to study with Collier⁸ the results of over a hundred consecutive elective splenectomies at the University of Michigan Hospital. As would be expected, in this study, the results in the patients with Banti's syndrome are the most disappointing.

At times in other diseases such as congenital or acquired hemolytic anemia, idiopathic thrombocytopenic purpura,¹² Gaucher's disease, malaria, the Cruveilhier-Baumgarten syndrome,⁹ and so on, one can easily imagine circumstances which would warrant selection of splenic artery ligation over splenectomy. However, in most instances, in a disease such as idiopathic thrombocytopenic purpura in which the possible presence of accessory spleens might be an important factor in the patient's recovery, splenic artery ligation is apt not to be effective treatment.

There is a further important, although rare, disadvantage to a too widespread preference for splenic artery ligation over splenectomy in cases of splenomegaly where the latter operation can be done with relative safety. Rarely an enlarged spleen is due to a primary splenic neoplasm and this lesion might go unrecognized if only the splenic artery were tied. This disadvantage applies to any operation in which the spleen is not removed. The following case illustrates this point. In this patient a splenic artery ligation was attempted and abandoned because the artery could not be found. Splenectomy was car-

FIG. 1

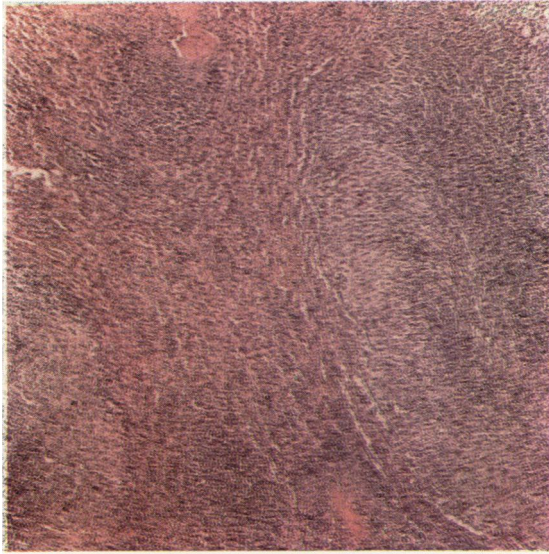


FIG. 2

FIG. 1.—Case mentioned in Discussion: Splenectomy was carried out after attempt to ligate the splenic artery was abandoned. Clinical diagnosis was cirrhosis with portal hypertension and Banti's syndrome. However, the spleen was found to be the site of a primary lymphoma unrecognized during the operation. External and cut surfaces of spleen show yellowish-white neoplastic nodules which have replaced parenchyma.

FIG. 2.—Photomicrograph showing edge of giant follicle in which change to Hodgkin's granuloma is apparent. Hematoxylin and eosin stain. x 40.

ried out and a splenic neoplasm discovered. In other clinics, a portacaval anastomosis might well have been performed, leaving the neoplasm *in situ*.

(A. B. H. No. 49-258) A 54-year-old white male was admitted to the hospital January 15, 1949, complaining of a swollen abdomen and legs of 5 weeks duration. He had been a heavy drinker for 12 years and had a recent episode of vomiting "coffee ground" material. Liver function tests revealed impairment of function and he exhibited numerous spider angiomata on the face, shoulders and chest. His total proteins were only 3.5 Gm. and his albumin-globulin ratio was reversed (serum albumin 2.5 Gm. and serum globulin, 1.0 Gm.). His hemoglobin was 14 Gm. (91 per cent), and the white cell count was 5,800. There were 64 per cent polymorphonuclear leukocytes and 36 per cent lymphocytes with no particular morphologic abnormalities. On January 26 the prothrombin concentration was 20 per cent of normal. Following paracentesis, the liver and spleen were found to be markedly enlarged to palpation. A diagnosis of Laennec's cirrhosis with portal hypertension and Banti's syndrome was made. It was also suspected that he had bleeding esophageal varices although this was not demonstrated by roentgenographic studies.

On January 19, splenic artery ligation was attempted because of the splenomegaly and the patient's generally poor condition. A careful and unsuccessful search for the splenic artery was made along the superior border of the pancreas. Possibly the artery was imbedded deep in the pancreas or was somewhere posterior to it. Splenectomy was done (A. B. III) and a spleen weighing over 1900 Gm. removed. The spleen measured 21 cm. in its greatest diameter (Fig. 1). On cut section, yellowish-white neoplastic nodules were seen diffusely distributed throughout the parenchyma. The histologic features of Hodgkin's disease developing in a giant follicular lymphoma were present (Fig. 2). This lymphoma was apparently primary in the spleen.

In addition to the first operation performed by the senior author cited previously in this communication, the following authors who have performed splenic artery ligation should be mentioned:

1. *Alessandri of Rome, Italy*.¹⁰ Sixteen splenic artery ligations up to 1938 were reported. He was especially pleased with his results in the two patients in his series who had Banti's syndrome.

2. *Watson of England*.¹¹ In a 26-year-old woman with splenic enlargement since the age of seven years and with marked preoperative ascites and bouts of hematemesis, ligation of the splenic artery reduced the ascites. Abdominal paracentesis was less frequently required and the patient was healthy and working without hematemesis three years later.

3. *Berg and Rosenthal of New York*.¹² These authors ligated the splenic artery in three patients with splenomegaly due to cirrhosis of the liver. All patients had had hematemesis preoperatively. While all patients were dead within a three-year period, one patient was greatly improved until a massive hematemesis three years postoperatively. The other two patients died within a year, one after subsequent splenectomy.

4. *Maggiore in 1941*¹³ reported favorable results in splenic artery ligation for splenomegaly due to cirrhosis.

5. *Everson and Cole of Chicago*,⁶ already cited, deserve credit for re-emphasizing this operation to surgeons in this country. One of their three patients with splenomegaly due to cirrhosis improved immediately postoperatively and

was well one year later. The second patient was improved and alive three years after operation, although ascites persisted. The third patient died four months after ligation. In all three patients omentopexy was performed in addition to splenic artery ligation, but improvement was not believed to have been due to this procedure.

6. *Linton and Hardy of Boston.*¹⁴ Recently Hardy suggested splenic artery ligation as a first-stage procedure in a two-stage spleno-renal anastomosis for poor risk patients with portal hypertension. This was carried out in a 50-year-old man with cirrhosis of the liver and continued esophagogastro-intestinal bleeding. A month later, the patient was re-admitted to the hospital and a splenectomy and end-to-side spleno-renal shunt were performed. The patient withstood the second stage well. These authors stated in August, 1949¹⁴ that in their opinion the patient could not have withstood the shunting operation if it had been done without the previous splenic artery ligation.

SUMMARY

In our present series, two patients had Banti's syndrome unassociated with obvious hepatic cirrhosis. The first of these has survived and was well 34 years postoperatively. The second patient was completely well for one year. Jaundice and other symptoms possibly due to gallstones are now impairing her health two years postoperatively and further operative procedures will be necessary.

Three patients had splenomegaly due presumably to portal hypertension, as definite cirrhosis of the liver was present concomitantly. The first of these is well more than two years postoperative without recurrence of ascites. The second patient died four months after operation with recurrence of ascites. In this case, the patient was unco-operative after operation and would not submit to paracentesis. The third is well more than ten months after operation.

CONCLUSIONS

1. Ligation of the splenic artery, first studied experimentally, and first performed for Banti's syndrome in 1913 by the senior author, has never been a widely employed operation but deserves broader application and more frequent use than heretofore.
2. The history, rationale, technic and results of this operation have been reviewed and its present indications defined.
3. Results in five cases have been presented.
4. Ligation of the splenic artery is the operation of choice in selected (poor risk) patients with splenomegaly due to portal hypertension, Banti's syndrome and occasionally other splenopathies.
5. In patients with portal hypertension, if spleno-renal anastomosis cannot be carried out because of the patient's condition or the surgeon's lack of experience with this operation, splenic artery ligation is preferable to splenectomy. There is less interference with anastomotic venous pathways and subsequent spleno-renal anastomosis will be easier if the patient's improvement permits.

BIBLIOGRAPHY

- ¹ Blain, A. W.: Ligation of the Splenic Artery for Banti's Disease. Report of Case, Experimental Studies. *Surg., Gynec. & Obs.*, **26**: 660, 1918.
- ² Whipple, A. O.: The Problem of Portal Hypertension in Relation to the Hepatosplenopathies. *Ann. Surg.*, **122**: 449, 1945.
- ³ Blakemore, A. H.: Portacaval Anastomosis: A Report on Fourteen Cases. *Bull. New York Acad. Med.*, **22**: 254, 1946.
- ⁴ Blalock, A.: Use of Shunt or By-Pass Operations in Treatment of Certain Circulatory Disorders Including Portal Hypertension and Pulmonic Stenosis. *Ann. Surg.*, **125**: 129, 1947.
- ⁵ Carter, B. N.: The Combined Thoraco-Abdominal Approach with Particular Reference to Its Employment in Splenectomy. *Surg., Gynec. & Obst.*, **84**: 1019, 1947.
- ⁶ Everson, T. C. and W. H. Cole: Ligation of the Splenic Artery in Patients with Portal Hypertension. *Arch. Surg.*, **56**: 153, 1948.
- ⁷ Blain, A. W.: Ligation of the Splenic Artery. Progress Report of Case Operated 34 Years Ago for Banti's Disease with a Discussion of Present Indications. *Alexander Blain Hosp. Bull.*, **6**: 152, 1947.
- ⁸ Coller, F. A., A. Blain, III and G. Andrews: Indications for and Results of Splenectomy. Charles C. Thomas, Springfield, Illinois. In Press.
- ⁹ Blain, A., III and M. Clapper: The Cruveilhier-Baumgarten Syndrome. *New England J. M.*, **232**: 647, 1945.
- ¹⁰ Alessandri, R.: Experiences with Surgery of the Spleen: Report of Two Unusual Cases. *J. Mt. Sinai Hosp.*, **4**: 489, 1938.
- ¹¹ Watson, R. B.: Ligation of the Splenic Artery for Advanced Splenic Anemia. *Brit. M. J.*, **1**: 821, 1935.
- ¹² Berg, A. A., and N. Rosenthal: Ligation of the Splenic Artery for Thrombocytopenic Purpura and Congestive Splenomegaly. *J. Mt. Sinai Hosp.*, **8**: 382, 1942.
- ¹³ della Maggiore, B. D.: Cited by T. C. Everson, and W. H. Cole.⁶
- ¹⁴ Linton, R. R., and I. B. Hardy, Jr.: Surgery of Portal Hypertension. Portacaval Shunts and a Two-Stage Method in the Poor Risk Patient. *J. Michigan State M. Soc.*, **48**: 1005, 1949.

BOOKS RECEIVED

- | | |
|---|---|
| BRUNNER, A. HENSCHEN, C. HEUSSER, H. JENTZER, A. SCHURCH, O. VEYRASSAT, J. | <i>Lehrbuch der Chirurgie.</i> Benno Schwabe & Co., Basle, Switzerland, 1949. |
| PRATT, GERALD H. | <i>Surgical Management of Vascular Diseases.</i> Lea & Febiger, Philadelphia, Pennsylvania, 1949. |
| KEYNES, GEOFFREY | <i>The Portraiture of William Harvey.</i> Henry Schuman, Inc., 20 East 70th Street, New York, New York, 1949. |
| BEDER, OSCAR EDWARD | <i>Surgical and Maxillofacial Prosthesis.</i> King's Crown Press, New York, New York, 1949. |