Porto-Renal Shunt: *

A New Technic for Porto-Systemic Anastomosis in Portal Hypertension

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Porto-systemic shunt operations have today well defined and ever increasing indications.

The purpose of this article is not to discuss the various indications for the procedure, nor the advantages of one shunt over another, but to describe a new technic which we have evolved to overcome certain technical difficulties which may arise in the construction of a porto-caval shunt of any type, whether it be the side-to-side, the McDermott double shunt, or even the simplest end-to-side shunt.

The technical difficulties may be due to several factors, either alone or in combination. 1) The anatomical distance between the portal vein and the vena cava may be great; 2) the portal vein may be very short. This, occurring together with the first factor, may preclude even the construction of an end-to-side shunt; and 3) an enlarged, hypertrophied caudate lobe, often found in hepatic cirrhosis, or in hepatic venous outflow occlusion, may be an insuperable obstacle in the approximation of the two veins.

These problems, when encountered, could be solved if a vein of sufficient caliber would be available to bridge the gap between the two systems. A free venous autograft interposed between the two structures usually does not succeed because of frequent thrombosis due to the relatively slow venous flow. Furthermore, the difficulty in procuring a sufficiently wide vein for grafting usually necessitates using a narrower vein such as the greater saphenous vein, and altering its diameter. This, together with the additional work of two difficult anastomoses instead of one, makes the operation most tedious, and when one also takes into account the great probability of thrombosis in the graft, the procedure becomes unjustifiable. Fortunately, there is one large tributary of the vena cava in this region available for efficient shunting of the portal to the caval system. This is the left renal vein, the anatomical position of which makes it almost predestined for this procedure. The use of this vein, after transection, provides a wide venous channel and furthermore, only one anastomosis needs to be performed. The probable theoretical incidence of thrombosis in such a shunt is not likely to be greater than with the direct porto-caval shunt, as the diameter of the renal vein is approximately the same as that of the dilated portal vein.

The problem, however, is the fate of the left kidney after transection of its vein and ligation of the distal end. Can the kidney survive the sudden loss of its normal venous drainage and are the natural systemic anastomoses sufficient to drain the kidney and maintain its normal function?

With this in mind, we were greatly impressed by a case in which an enormous echinococcal cyst of the liver compressed and obstructed both renal veins and the vena cava above them to produce, in effect,

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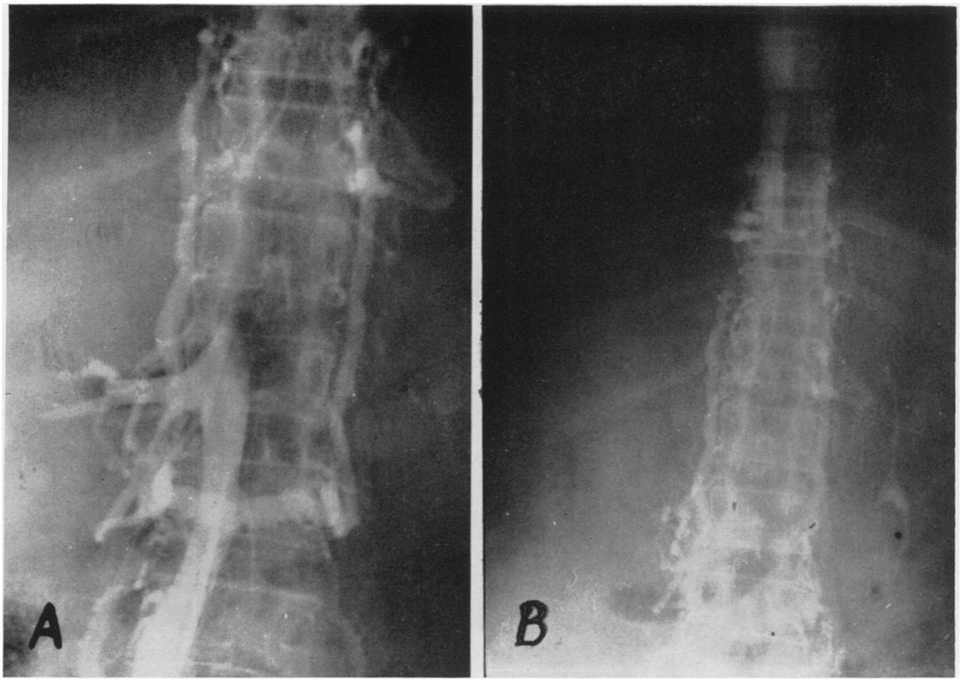

FIG. 1. Cavogram in a case of compression and obstruction of inferior vena cava by a hydatid cyst of liver. A. Collateral venous circulation, through transverse lumbar and ascending lumbar veins. Renal veins not filled. B. Azygos veins, and normal excretory pyelogram of the left kidney. No excretion seen from the right kidney (confirmed by control intravenous pyelography).

a severe inferior vena cava obstruction syndrome. The right kidney had ceased to function, but the left kidney was functioning normally despite the fact that its normal venous outflow to the vena cava was completely blocked. The natural renosystemic anastomoses were quite sufficient to ensure drainage and full function of the kidney (Fig. 1).

In a study of the pararenal system of veins, Anson and associates write: "The renal venous pattern of the right side bears little appearance to that of the left. In its relatively short course from the kidney to the inferior vena cava, the right renal vein rarely receives a tributary. . . . The longer left renal vein, on the contrary, regularly receives the following tributaries: suprarenal and inferior phrenic, from above, frequently by a common, or confluent channel; spermatic (or ovarian) and second, or third lumbar veins from below, likewise often by a confluent vessel. . . . On the retro-aortic, or prevertebral, level, complexity in venous pattern occurs; the retro-aortic members of the plexus regularly communicate with lumbar veins, and the retro-aortic set of veins is often associated with the deeper division of a circum-aortic venous ring. . . . In company with the main caval channel, less capacious longitudinal veins commonly course from the lumbar to thoracic levels. These may be found arising from the dorsal aspect of the inferior vena cava or the left renal vein." Anson summarizes his anatomical study: "The left renal vein is found to be situated at the core of an impressive set of venous plexuses and veins: inferior phrenic and suprarenal tributaries enter from above; from below and to the side come spermatic (or ovarian), capsular, lumbar, and ascending lumbar veins, and the anomalous vena cava. Additionally,

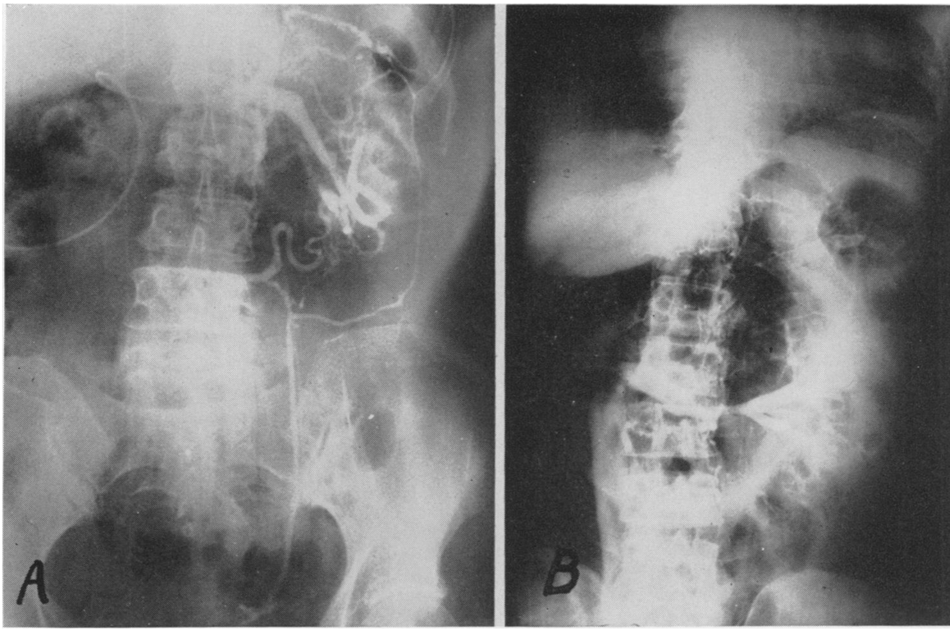

FIG. 2. Filling of left renal vein of cadaver with contrast medium. Showing right anastomotic network. *A*. Note the spermatic and suprarenal, capsular, ascending and transverse lumbar and azygos veins. Anastomosis between ureteric and superior gluteal veins can be seen. *B*. Note periaortic plexus of veins. Filling of the inferior vena cava by transverse lumbar veins.

commmunication is made with azygos and hemiazygos veins (usually through lumbars) and with the extensive set of internal and external vertebral plexuses by way of intervertebral and lumbar veins."

In order to confirm the patency and efficiency of these rich reno-systemic *bypass* anastomoses, we performed the following studies.

In a series of unselected cadavers immediately after death, the left renal vein was ligated 4 to 5 cm. distal to the inferior vena cava. A radio-opaque solution (30 cc. of 12% sodium iodide solution) was injected distal to the ligature and x-ray photographs taken immediately afterwards. In all the cases, the solution quickly passed from the renal vein into the many collateral channels (Fig. 2).

This was repeated on two patients at operation in which the left kidney was to be removed for hydronephrosis. Through a transverse abdominal incision, the left renal vein was identified at its junction with the inferior vena cava and ligated about 4 cm. distal to the junction. Into the distal part, 30 cc. of Hypaque 50 per cent was injected and an x-ray picture taken. In both cases, the dye passed rapidly from the renal vein and disappeared through the many collaterals.

These studies confirm that transection and ligation of the left renal vein proximal to its tributaries should not interfere with the function of the kidney. Since the confluence of the suprarenal and spermatic (ovarian) veins with the left renal vein lies 2 to 4 cm. from the kidney hilus, the proximal 5 to 7 cm. of the left renal vein is available for the shunt procedure.

The technic of the operation is as follows: The portal vein is dissected and prepared. Next, the inferior vena cava is dissected a few centimeters above and below the left renal vein. The dissection is then continued along the left renal vein. This is easily performed, since as previously mentioned, the first 5 to 7 cm. is free of tributaries, and lies in the loose areolar tissue behind the pancreas which is simply retracted to give ample space for dissection. The vein is transected approximately 5 cm. from the vena cava and the distal part transfixed and ligated. The renocaval angle is now cleared of all adventitious tissue and a Shatinsky clamp applied to the vena cava immediately beneath the junction with the renal vein. The stump of the renal vein is turned towards the portal vein and the two are approximated without tension. An end-to-end or side-to-end porto-renal shunt can now be easily performed. After release of the clamps there is a free flow through the short renal vein bridge (Fig. 3).

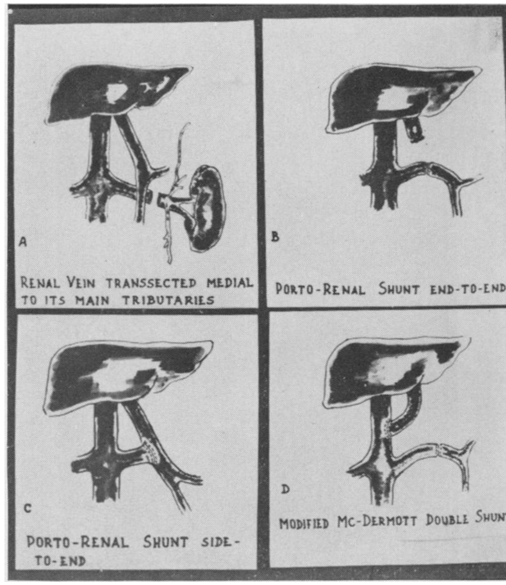

FIG. 3. Types of porto-renal shunts. A. Diagram of venous outflow of the left kidney after transection of renal vein. B. End-to-end-porto-renal shunt. C. Side-to-end porto-renal shunt. D. Double shunt end-to-end and end-to-side.

We have constructed porto-renal anastomosis in five cases, two end-to-end and three side-to-end. Two patients died. One was a 66-year-old man with profuse bleeding from varices due to hepatic cirrhosis, and with grossly impaired liver functions, in whom the operation was performed as a last resort. After clamping the portal vein, the pressure on the hepatic side of the clamp remained high and therefore it was decided to do a side-to-side porto-caval anastomosis. It was, however, impossible to do this due to the presence of a huge caudate lobe. This technical problem was easily solved by doing a porto-renal shunt. The patient died five days after operation from hepatic failure. At postmortem examination, the shunt was perfectly patent. The left kidney appeared normal with no signs of stasis, or other impairment of venous outflow.

The second fatal case was a two-year-old child with a huge liver and *malignant* ascites of four-month duration. The ascites rapidly recurred after repeated aspiration. Liver needle biopsy confirmed the suspected diagnosis of Budd-Chiari syndrome. There appeared to be little hope for this child, but it was believed that a side-to-side porto-caval shunt should at least be attempted. At operation, this was found to be technically impossible, but a porto-renal shunt was quite easily performed. Unfortunately the child went into shock at the end of the operation and died shortly afterward. Postmortem examination showed a well constructed shunt.

The third case was a 58-year-old man with ascites of six-month duration, which recurred rapidly after repeated aspirations, who was found also to have marked splenomegaly and pancytopaenia.

Needle biopsy of the liver showed slight portal space fibrosis. On splenoportography, an enlarged portal vein was present, with stasis in the smaller venous ramifications in the liver. The pressure recorded during spleno-portography was 34 cm. of water.

At laparotomy about two liters of ascites was aspirated. Frozen section examination of a liver biopsy showed severe venous stasis suggestive of outflow occlusion. This was confirmed by measuring the pressure after occlusion of the portal vein. The

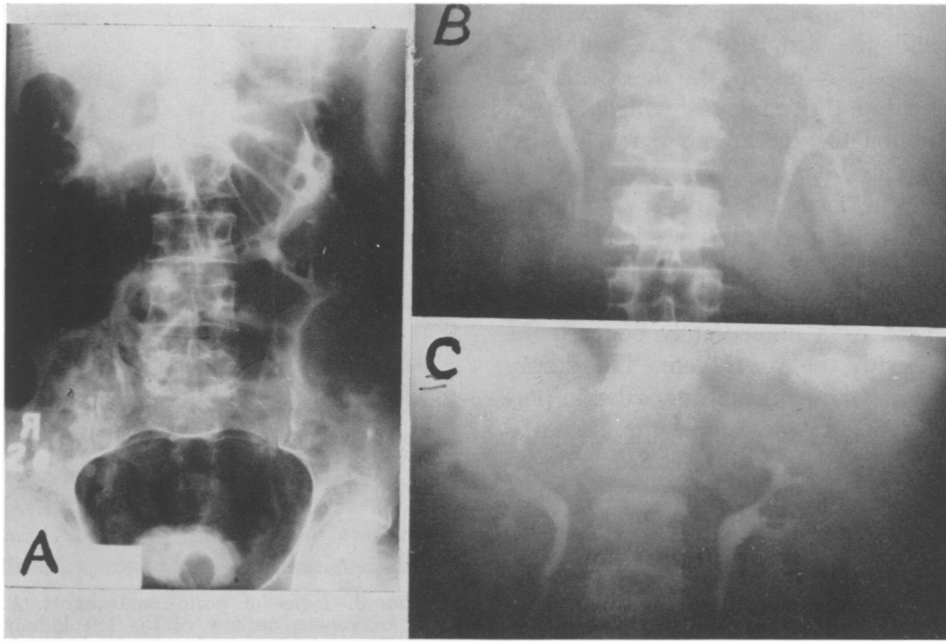

FIG. 4. Postoperative excretory pyelograms showing normal excretion of the left kidney. A. (Case 3). Seventeen days after side-to-end porto-renal shunt. B. (Case 4). Six months after end-to-end porto-renal shunt. C. (Case 5). Six months after end-to-end porto-renal shunt.

pressure in the portal vein on the hepatic side of the clamp remained high and unchanged. Because of this, a side-to-side porto-caval anastomosis was planned, but owing to the presence of a large caudate lobe, the portal vein could not be approximated to the vena cava. This problem was overcome easily by using our technic. A side-to-end porto-renal anastomosis was constructed. The postoperative course was uneventful. The urinary output was normal. Intravenous pyelography performed 17 days after the operation, showed a normally functioning left kidney (Fig. 4). Splenoportography done on the twenty-first postoperative day showed a perfectly functioning shunt (Fig. 5).

FIG. 5 (Case 3). Side-to-end porto-renal shunt. Spleno-portogram 3 weeks after operation. Note filling of portal vein to the hilum of the liver as well as immediate filling of inferior vena cava (by chance the injection was directly into a branch of the splenic vein, giving excellent contrast).

The two other cases had identical symptoms and pathology. Both had severe and repeated hemorrhages from esophageal varices, recurring lately at short intervals. Both had been suffering for years from hepatic cirrhosis. Spleno-portography showed intrahepatic portal obstruction. At operation, the portal vein was short and a protruding caudate lobe interfered with the construction of a porto-caval shunt. In both cases an end-to-end porto-renal shunt was made.

Both patients are doing well seven and eight months after operation. There has been no bleeding since the operation and on follow up x-ray studies, the large esophageal varices are no longer seen. Follow up postoperative spleno-portography in both cases shows a perfectly functioning shunt with the dye passing rapidly from the portal vein to the inferior vena cava (Fig. 6).

In both cases there was no sign of damage to the function of the left kidney, neither immediately after operation nor later. Intravenous pyelography done four weeks after operation showed the left kidney to be functioning normally and no different to the preoperative pyelogram. The intravenous pyelogram was repeated six months after the operation and again confirmed that the left kidney was functioning normally (Fig. 4).

Summary and Conclusions

A new technic in porto-caval shunt operations is described, in which the proximal end of the left renal vein is used to bridge the gap between the portal vein and the inferior vena cava in cases in which these cannot be directly joined due to either a great anatomical distance between them, a protruding hypertrophied caudate lobe, a short portal vein or combinations of these.

Anatomical studies show that the tributaries of the left renal vein enter close to the hilum of the kidney leaving the proximal 5 to 7 cm. of the vein free of branches.

Outflow studies on cadavers and on patients at operation show that the normal systemic anastomoses of the left renal vein can adequately cope with the venous drainage of the kidney after ligation of the vein medial to the point of entry of its tributaries. The function of the kidney should therefore not be impaired.

These features of the left renal vein allow one to use it as a bridge between the portal vein and inferior vena cava in

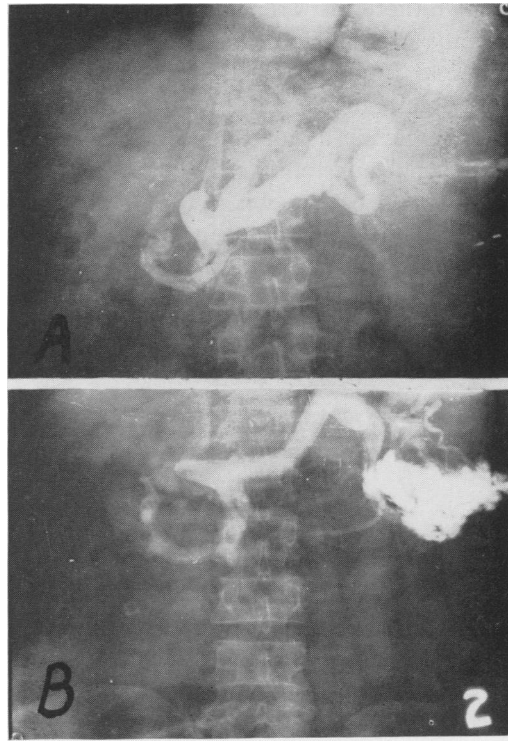

FIG. 6. Postoperative spleno-portograms, showing immediate filling of inferior vena cava through the end-to-end porto-renal shunt. A. (Case 4). Five months after operation. B. (Case 5). Four months after operation.

cases where a porto-caval anastomosis is necessary, but either difficult or impossible by the usual technics. We have taken advantage of this in five cases. The left renal vein was transected five cm. distal to the inferior vena cava, the renal end ligated and the proximal end anastomosed to the portal vein.

Two patients died of causes unconnected with the type of shunt. One, a two-year-old child, of shock immediately after operation. The second, a 66-year-old man with severe liver cirrhosis, died of liver failure five days after operation. The left kidney on postmortem examination was normal and showed no signs of impaired venous outflow.

Three of the patients survived and are doing well. In these, postoperative splenoportography shows well functioning shunts.

In all these cases repeated follow up postoperative intravenous pyelograms show unimpaired function of the left kidney.

The left renal vein was used in two ways, either in a side-to-end or end-to-end porto-renal anastomosis.

We believe that when the McDermott type double shunt is preferred, the use of the renal vein stump could greatly simplify the technic.

The possibility of using the long renal vein stump for mesenterico-renal shunt instead of the problematic cavo-mesenteric anastomosis, is at present being studied.

Addendum

Since preparation of this paper, another patient had been operated upon for ligation of the left renal vein. Postoperative follow-up investigations show normal function of the left kidney.

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THE EVOLUTION OF SURGERY IN THE U. S., by Allen O. Whipple. Charles C Thomas, 1963, $6.50.

THIS short 180-page volume by Dr. Allen O. Whipple appears posthumously. It is kindred to another historical work, "The Story of Wound Healing and Wound Repair," which was published one month before he died. As the title implies emphasis is on surgery and surgeons in the United States, but much of the erudition and lore of general history which marked the first book shines through in side remarks in this second one.

In the preface Dr. Whipple indicated that the work was directed both to surgeons and those who have been subjected to surgical operations. Two audiences which would seem to be widely separated targets, simple, straightforward writing, numerous personal anecdotes, and a teacher's clear notion of the subject, however, accomplish the broad aim.

There are stories about people: surgeons, such as McDowell and Beamont; patients, such as Mrs. Crawford and Alexis St. Martin; diseases, such as cancer of the breast and adenomata of the pancreas; medical schools; hospitals; and even some advice to older surgeons about retirement.

To those readers, surgeons or patients, who knew Dr. Whipple there are many poignant items which will bring him back to life; to those who did not know him a nice picture of a gentle wise surgeon will emerge.—JOHN H. MULHOLLAND, M.D.

BLOOD VOLUME, by Solomon N. Albert, Charles C Thomas, 1962, $8.50.

THIS is a comprehensive and timely monograph on blood volume. It is divided into two sections. The first section relates numerous physiological principles involved in blood volume studies such as factors which regulate blood volume, normal content and distribution of blood in health and disease, hematocrit determinations as related to blood volume, and an interesting chapter on blood volume as affected by anaesthesia with which the author has personal experience. The second section clearly describes methods and principles of blood volume determination with a detailed and lucid discussion of current use and dilution measurement of radioisotopic tracers.

Both sections of the book are reinforced by interesting sketches, charts and photographs which simplify the complexity of factors involved in blood volume study.

This monograph should be available to all surgeons because of extensive operations being undertaken on an increasingly older population. The numerous facets of the subject of blood volume, standards, normals, and difficulties in accurate determinations make one realize the need for careful clinical appraisal of each individual patient.—NATHAN LIBBY, M.D.

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