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ASPECTS OF TREATMENT*

The anatomical basis for portal decompressive surgery

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Summary

Definitive surgical techniques used in the treatment of portal hypertension all aim to achieve portal venous decompression. The historic development of the various procedures currently employed provides a broad repertoire of surgical operations. Each of the procedures merits consideration and may be specifically indicated in a given situation. Description of the operative steps emphasizes the importance of the anatomical relationships of the various structures.

Introduction

In 1877 Lauthenbach[1] stated, erroneously as it transpired, that hepatic failure was inevitable in dogs after portal vein occlusion. Eck[2], however, very quickly demonstrated that the portal vein in dogs could be ligated with impunity if an anastomosis was created between the splanchnic end of the occluded portal vein and the inferior vena cava, thereby shunting the portal blood directly into the systemic circulation. A quarter of a century went by before Tansini[3] introduced the experimental equivalent of the modern end-to-side portacaval shunt by dividing the portal vein obliquely and suturing the splanchnic end of this vessel into the anterior wall of the vena cava. A further decade elapsed before Franke[4] devised the experimental side-to-side portacaval shunt without ligation of the portal vein.

In 1945 Blakemore and Lord[5] introduced into clinical surgery the end-to-side splenorenal anastomosis using a vitallium tube for the venous anastomosis after removal of both the spleen and the kidney. This operation was subsequently modified by Linton *et al.*[6] and Milnes-Walker[7], who conserved the kidney and performed a direct end-to-side venous anastomosis. Though Vidal[8] had applied the portacaval anastomosis in 1910 for ascites, this operation had fallen into disrepute until it was revived by Satinsky[9], who in 1948 advocated a right thoracoabdominal incision to permit its performance with greater ease and safety. In this manner the end-to-side portacaval anastomosis was developed, and subsequently McDermott[10] recommended a double-barrelled portacaval shunt in the treatment of cirrhotic ascites.

Portacaval shunt

In our earliest cases a right thoracoabdominal incision provided the standard approach to this procedure, but for the past 10 years we have successfully used a long subcostal abdominal incision, which provides adequate access for exposure of the portal vein and inferior vena cava. Whichever approach is used a thorough exploration will confirm the diagnosis, and if a previous liver biopsy specimen is not available this is now taken and sent for histological study.

As a preliminary step a suitable branch of the superior mesenteric vein in the upper jejunal mesentery is dissected out and cannulated with a size 14 or 16 intravenous needle to which polyethylene tubing of suitable size and length is attached and then may be led to a 3-way stop-cock, permitting manometric assessment of pressure as well as preshunt and, if required, postshunt portography.

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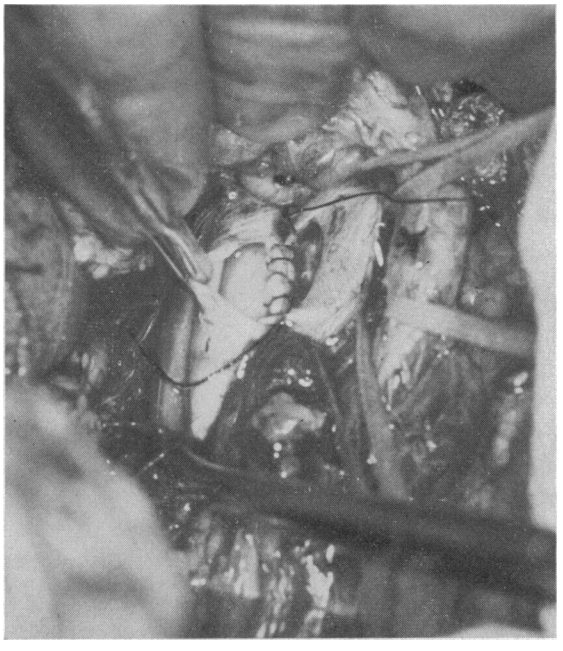

FIG. 1 *With the common bile duct retracted to the left by an encircling tape the posterior row of sutures between side of portal vein and side of inferior vena cava has been completed.*

Dissection of portal vein After the foramen of Winslow has been defined and the second part of the duodenum and the hepatic flexure of the colon mobilized an incision is made in the posterior peritoneal margin of the foramen. The common bile duct is identified, freed, and retracted medially by a tape placed around it (Fig. 1).

Careful dissection is then employed in mobilizing the turgid portal vein, great care being taken not to injure collateral vessels, particularly the pancreatic branches. The portal vein is then skeletonized, being mobilized in its full extent from the upper border of the duodenum to the hilum of the liver so that if possible its right and left branches can be defined and ligatures placed about them.

Exposure of inferior vena cava Retraction of the mobilized duodenum permits clearance of the anterior and medial aspects of the inferior vena cava from the level of the left renal vein to its disappearance behind the liver.

On occasion, if the inferior vena cava cannot be used in construction of a shunt, the left renal vein may be divided, the distal end ligated, and the proximal end brought up for anastomosis to the portal vein, renal venous drainage being subsequently possible through collateral venous channels.

End-to-side portacaval anastomosis After ligation of the upper part of the portal vein or its two major branches a vascular clamp is placed on the main portal trunk as low down as possible and the vein is divided to provide the greatest possible length of vessel. A suitable curved clamp of the Satinsky type is then placed on the anteromedial wall of the inferior vena cava and a vertical incision made so that its length is half the circumference of the divided portal vein (Fig. 2).

The end-to-side anastomosis is constructed with a continuous everting 5–0 vascular silk suture, and after completion of the anastomosis light pressure on the suture line for a few moments will control any venous leakage after the clamps are removed.

The haemodynamic turbulence at the anastomosis is usually readily apparent and a final portal pressure reading will attest to the suc-

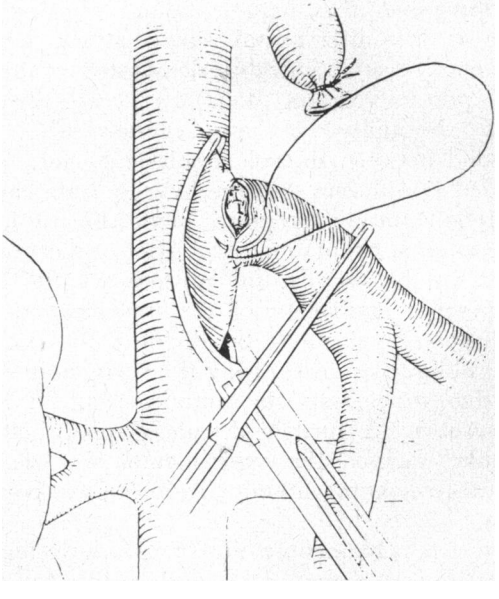

FIG. 2 *Diagrammatic representation of end-to-side portacaval anastomosis.*

cess of the procedure by showing a marked fall, which is usually greater than 100 mm H_2O (1kPa).

Side-to-side portacaval anastomosis Although we have preferred a side-to-side anastomosis in the presence of ascites or ammonia intoxication with encephalopathy, the presence of a large caudate lobe of the liver has on occasion precluded its use.

Proximal and distal clamp control of the portal vein and oblique control of the anterior wall of the inferior vena cava precedes approximation of the two vessels after ellipses of the venous walls have been excised to provide an anastomosis about 2 cm in diameter, using a 5–0 continuous everting silk suture (Fig. 3).

Wound closure After exploration through a subcostal abdominal incision closure is performed in appropriate layers. If an abdominothoracic approach has been used with division of the diaphragm, then repair of the diaphragm with interrupted silk sutures is followed by closure of the pleura. Closure of the peritoneum and the remainder of the wound proceeds along standard lines.

Splenorenal (lienorenal) anastomosis Controversy has long centred about the relative merits of the portacaval and splenorenal shunts in establishing a lasting portal decompression. Although Linton *et al.*[6] argue in favour of the splenorenal shunt, pointing out that this provides an effective decompression without the danger of ammonia intoxication, Wantz and Payne[11] have stressed the inadequacy of portal decompression in their patients with splenorenal anastomoses, so that generally this procedure has lost favour.

End-to-side splenorenal anastomosis In the early development of this operation removal of the spleen and left kidney were necessary to permit an end-to-end splenorenal anastomosis, but subsequent refinements by Linton *et al.*[6] and Milnes-Walker[7] have permitted the development of an end-to-side splenorenal anastomosis which has been reserved in our hands for those cases in which the portal vein has been unavailable for a shunting procedure or, on occasion, when gross hypersplenism has been a dominant clinical expression of portal hypertension.

Splenectomy in these circumstances is not a simple operation because of the many vascular adhesions. The splenic vein is not as satisfactory as the portal vein for holding sutures; nor does it usually provide as large an opening, so that early thrombosis of the shunt is more liable to occur.

We have preferred a left abdominothoracic incision through the bed of the ninth rib to provide adequate access to the large, vascular spleen. In order to reduce the size and vascularity of the spleen we have practised early ligation in continuity of the splenic artery. This is carried out after making an opening in the gastrocolic ligament, dissecting out the splenic artery in the lesser sac as it pursues its tortuous course along the upper border of the pancreas.

In removing the spleen the splenic vein is retained intact until all other splenic attachments have been divided. In order to mobilize the necessary 3–5 cm of the splenic vein a few pancreatic branches will require ligation and division. A bulldog clamp appropriately placed will then provide adequate control, permitting distal division of the vein and removal of the spleen.

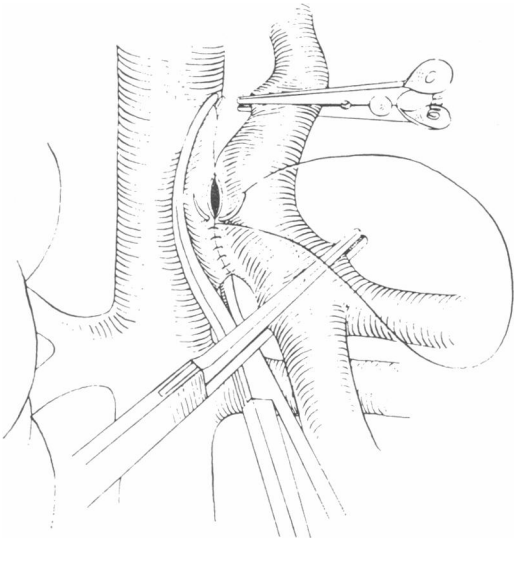

FIG. 3 *Side-to-side portacaval anastomosis.*

Mobilization of the left renal vein proceeds after reflection of the splenic flexure and descending colon, and the vein is then skeletonized, permitting partial occlusion of the renal vein and the placing of a transverse incision in its upper wall. The splenic vein is then brought down to it and an anastomosis fashioned with a continuous 5–0 silk everting suture (Fig. 4).

After removal of all clamps the postshunt pressure is checked and the wound closed in layers without drainage.

Side-to-side splenorenal anastomosis It has been suggested that the disadvantage of the small splenic vein lumen resulting from the end-to-side anastomosis can be avoided by mobilizing the splenic and renal veins and then fashioning a side-to-side splenorenal anastomosis. This procedure has been described by Warren *et al.*[12] but has not received general acceptance at present, although it does provide certain advantages—namely, an anastomosis of good calibre and an adequate portal decompression without great reduction in liver flow. It is therefore a technique that should be included in the broad repertoire of procedures in portal hypertension.

Distal splenorenal shunt The reduction in liver blood flow after portosystemic shunt procedures may in some patients predispose to progressive hepatic functional derangement leading to death from hepatic failure.

The studies of Hallenbeck *et al.*[13] suggested that splenectomy alone may provide survival rates identical with those resulting from portosystemic shunting operations, leading Peters and Womack[14] to design a devascularization operation complementing splenectomy with ligation of the left gastric veins to decompress the oesophageal varices.

These concepts led Warren *et al.*[12] to devise the distal splenorenal shunt with division of the splenic vein, ligation of the portal end of the divided vein, and implantion of the splenic end into the left renal vein. Ligation of the coronary (left gastric), right gastric, and right gastroepiploic veins disconnects the gastro-oesophageal venous circuit from the portal venous system (Fig. 5).

Unquestionably this procedure has the advantage of avoiding postoperative encephalopathy entirely. However, the level of portal decompression is not as great as with the currently more orthodox decompressive procedures, while the operation may at times be technically more difficult.

Increased experience with this procedure may justify its extended use if it provides protection from exsanguinating variceal haemorrhage and can be generally performed with an acceptably low operative mortality.

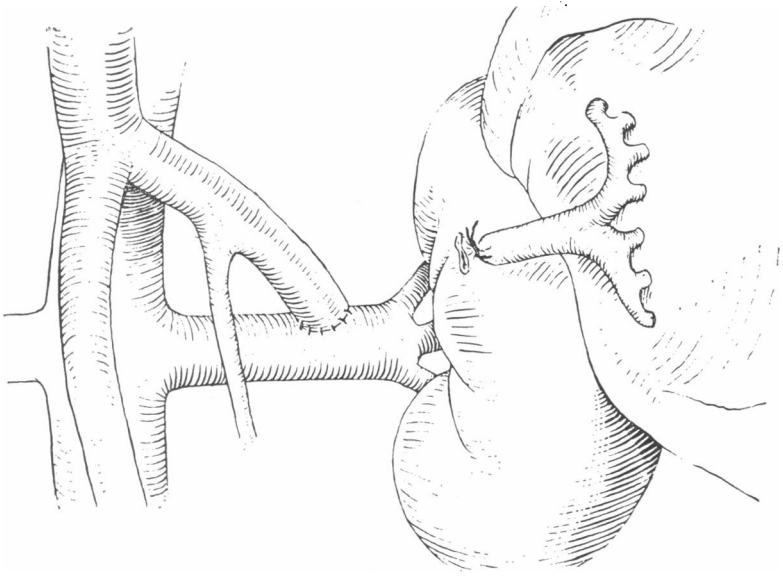

FIG. 4 *End-to-side splenorenal anastomosis after splenectomy.*

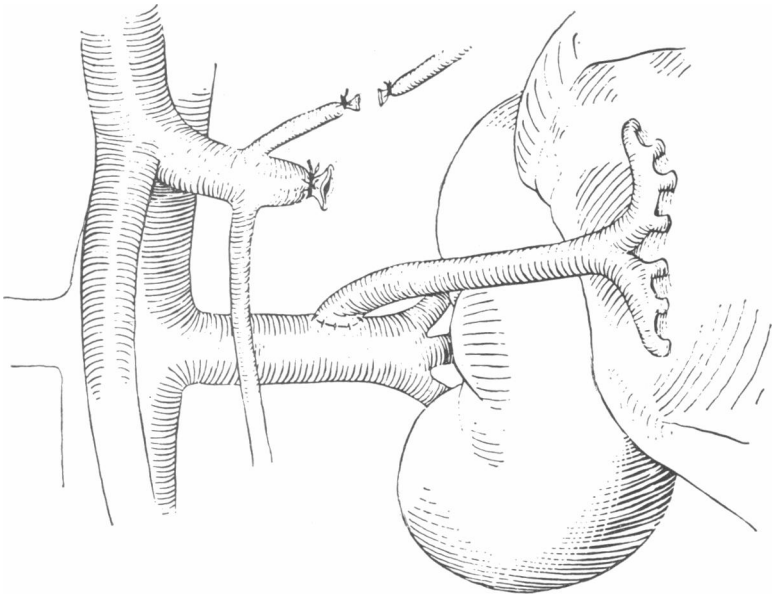

FIG. 5 *Distal splenorenal shunt with ligation of proximal end of divided splenic vein and divided left gastric vein.*

Mesenterocaval anastomosis

It is necessary to appreciate that there exists a group of patients with portal hypertension and bleeding oesophageal varices in whom neither portacaval nor splenorenal anastomosis is possible. This is usually associated with a combination of factors which prevent the practical use of the portal or splenic veins.

Marion[15] drew attention to the feasibility of constructing a portal–systemic shunt between the superior mesenteric vein and the inferior vena cava. He found a direct side-to-side shunt to be technically difficult, while the use of a bridging vein graft resulted in failure through thrombosis, but he was able to perform an end-to-side shunt using the transected inferior vena cava. Subsequently this technique was successfully used by Clatworthy and his colleagues[16] (Fig. 6), while Lord *et al.*[17] and Drapanas[18] have described a mesenterocaval shunt using an 18-mm Dacron graft interposed between the inferior vena cava and the superior mesenteric vein (Fig. 7).

Our experience with these operations leads us to believe that the mesenterocaval shunt provides a most useful surgical procedure in certain cases of portal hypertension and variceal hemorrhage.

Indications Wherever a combination of factors prevents practical use of the portal and splenic veins the feasibility of constructing a mesenterocaval shunt should be seriously considered. Such circumstances would include the following:

A) Portal vein unavailable.

1) Congential atresia of the portal vein with cavernous malformation.

2) Portal vein thrombosis or calcification prohibiting use of this vein.

3) Previous use of the portal vein in a portacaval anastomosis with closure of the shunt by thrombus or endothelial proliferation and recurrence of variceal haemorrhage.

B) Splenic vein concurrently unavailable.

1) Previous splenectomy. Unfortunately patients are still seen who have previously undergone injudicious splenectomy alone for variceal haemorrhage. Occasionally splenectomy has been performed for hypersplenism without the addition of a prophylactic splenorenal shunt; in these patients subsequent variceal haemorrhage inevitably occurs.

2) The splenic vein is small. The construction of a splenorenal shunt using a small-calibre vein as judged by splenoportography is doomed to failure because of an inadequate decompression or because of subsequent thrombosis of the shunt.

3) Thrombosis of the previously constructed splenorenal shunt.

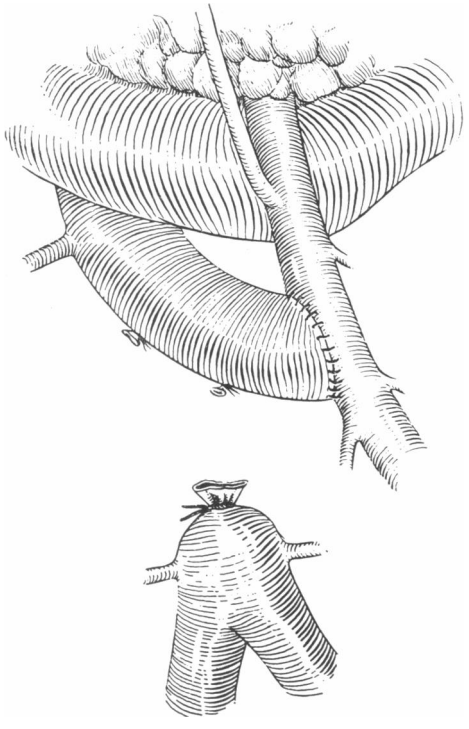

FIG. 6 *Mesenterocaval shunt using proximal end of divided inferior vena cava.*

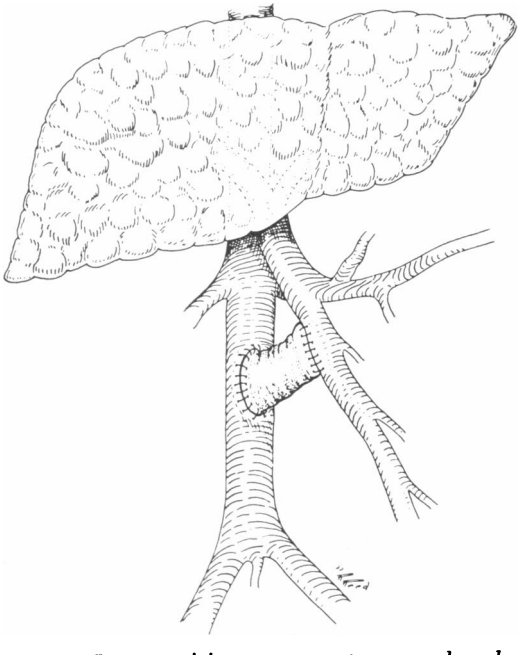

FIG. 7 *Interposition mesenterocaval shunt with* 18-*mm Dacron.*

Technical considerations *Preliminary portography* — If the spleen is present percutaneous splenic puncture provides a monitor of pulp pressure and an opportunity for transplenic portal venography. This will demonstrate the site of obstruction and indicate whether it is intrahepatic or extrahepatic as well as providing an index of the calibre of the splenic vein.

Operative portography — At the time of surgical exploration a mesenteric vein can be cannulated and pressure studies performed both pre- and postoperatively. At this time portography will demonstrate the patency and availability of the superior mesenteric vein as well as confirming the unavailability of the portal vein.

Abdominal exploration — Although this can be carried out through a vertical right paramedian incision and was the method used in most of our early cases, we have subsequently chosen an obliquely transverse supraumbilical incision extending from the left costal angle across the right flank, thereby providing access for any of the three main shunt procedures—portacaval, splenorenal, or mesenterocaval—depending on the special circumstances of the case. After confirmation of the diagnosis and completion of the operative portogram the decision may be made to proceed with the mesenterocaval anastomosis.

Mobilization of superior mesenteric vein— The base of the mesentery is put on the stretch by holding up the transverse colon in a cephalad direction, the jejunum being retracted to the left. This manoeuvre results in the line of reflection of the transverse mesocolon becoming well defined. An incision 4 cm long is then made in the base of the transverse mesocolon, the pulsation of the superior mesenteric artery acting as a guide to the vein, which is situated to its right. The middle and right colic vessels are identified and preserved, as are the other divisions and branches of the superior mesenteric vein, which is now readily mobilized.

Mobilization of inferior vena cava—Access is obtained to the inferior vena cava from its iliac vein junctions to the level of the

renal veins by mobilization of the duodenum by the Kocker manoeuvre. After the appropriate segmental lumbar veins have been clamped, ligated, and divided this segment of vena cava is mobilized, and if necessary the right gonadal vein may be ligated. After the vena cava has been cleared of its surrounding soft areolar tissue it is cross-clamped just below the level of the right renal vein, and after distal ligation at the level of the common iliac veins it is transected and the iliac vein stumps oversewn with continuous 5–0 arterial silk sutures. Two lateral stay sutures of 5–0 vascular silk are now placed through the distal orifice of the vena cava to provide a method of traction on the transected vein.

Creation of anastomoses—A tunnel is created in the areolar tissue at the root of the mesentery. The transected vena cava is then drawn through this tunnel and apposed to the right of the superior mesenteric vein, careful attention being paid to prevention of torsion or kinking of the vena cava as it is approximated to the mesenteric vein. The anastomosis is performed after clamp control of the superior mesenteric vein has been gained and a button of its posterolateral wall excised to provide a diameter equal to that of the opening into the vena cava. A continuous suture of 5–0 arterial silk is used to approximate the two veins and, after all clamps have been removed, the patency of the shunt may be demonstrated by evidence of turbulence at this area.

If the interposition graft is to be used less extensive mobilization of the inferior vena cava suffices and permits suture of a short segment of 18-mm Dacron to the sides of the vena cava and superior mesenteric vein.

References

1 Lautenbach, B F (1877) *Philadelphia Medical Times, 7,* 387.
2 Eck, N V (1877) *Meditsinskii Zhurnal, 130,* 1.
3 Tansini, I (1902) *Zentralblatt für Chirurgie, 29,* 937.
4 Frank, I (1912) *Zeitschrift für biologische Technik und Methodik, 2,* 262.
5 Blakemore, A H, and Lord, J W jr (1945) *Annals of Surgery, 122,* 476.
6 Linton, R R, *et al.* (1947) *Surgical Clinics of North America, 27,* 1162.
7 Milnes-Walker, R (1959) *The Pathology and Management of Portal Hypertension.* London, Arnold.
8 Vidal, E (1910) *Revue de chirurgie, 24,* 1181.
9 Satinsky, V P (1948) *Annals of Surgery, 128,* 938.
10 McDermott, W V jr (1958) *New England Journal of Medicine, 259,* 897.
11 Wantz, G E, and Payne, M A (1964) *New England Journal of Medicine, 265,* 721.
12 Warren, W D, *et al.* (1967) *Annals of Surgery, 166,* 437.
13 Hallenbeck, G A, *et al.* (1963) *Surgery, Gynecology and Obstetrics, 116,* 435.
14 Peters, R M, and Womack, N A (1961) *Annals of Surgery, 154,* 432.
15 Marion, P (1953) *Hôpital (Paris), 29,* 2781.
16 Clatworthy, H W, *et al.* (1955) *Archives of Surgery, 71,* 588.
17 Lord, J W jr, *et al.* (1970) *Surgery, Gynecology and Obstetrics, 130,* 525.
18 Drapanas, T (1972) *Annals of Surgery, 176,* 435.