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974

Orthotopic Liver Transplantation with Preservation of the Inferior Vena Cava

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Piggyback orthotopic liver transplantation was performed in 24 patients during a period of 4 months. This represented 19% of the liver transplantations at our institution during that time. The piggyback method of liver insertion compared favorably with the standard operation in terms of patient survival, blood loss, incidence of vascular and biliary complications, and rate of retransplantation. The piggyback operation cannot be used in all cases, but when indicated and feasible its advantages are important enough to warrant its inclusion in the armamentarium of the liver transplant surgeon.

ORTHOTOPIC LIVER TRANSPLANTATION is a well-standardized operation[1,2] in which the inferior vena cava from above the renal veins to the diaphragm is removed as part of the recipient hepatectomy. The excised retrohepatic vena cava is replaced with a donor vena caval segment into which all of the hepatic veins drain. The safety and ease of the operation have been improved by the use of a veno-venous bypass technique that permits the obstructed vena cava as well as the occluded splanchnic venous system to be decompressed during the anhepatic phase.[3]

We report here a piggyback modification of this procedure whereby the full length of the recipient inferior vena cava is preserved. This kind of operation has been performed before,[1-4] but it has not been fully described. A particularly appealing feature of the operation in children for whom veno-venous bypass might not be feasible is that vena caval occlusion can be avoided during the hepatectomy.

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Methods

Case Material

We have used the technique intermittently since the late 1960s. However retrieval of all cases in our experience proved to be impractical. For purposes of the present study, only the time between January 1988 through April 1988 was considered; at this time 24 piggyback operations were performed (compared to 103 standard procedures).

The results with the piggyback operation were compared with those in paired controls. The controls consisted of the pediatric or adult case immediately preceding the piggyback procedure (Table 1).

The age of the piggyback recipients ranged from 10 months to 60 years, mean 36 years. In the piggyback group, there were four children who were 10 months to 15 years old (mean, 7.1 years). The adults were 30 to 60 years old (mean, 42.1 years). The control population was almost identical (Table 1).

Surgical Technique

The hilar structures were dissected, ligated, and divided (Fig. 1). In some cases it was possible to rotate the liver out of the wound to dissect the individual hepatic veins (Fig. 2). The small hepatic veins were ligated and divided. The major veins were crossclamped (Fig. 3) because they were used to fashion an orifice for the outflow anastomosis of the homograft suprahepatic vena cava (Figs. 4 and 5). The three principal veins (right, middle, and left) were joined by dividing the intervening septa in 19 cases. The

TABLE 1. *Comparison of the "Piggyback" Versus the Standard Technique*

Variables	PB		Standard	
	Ped.	Adults	Ped.	Adults
Number of cases	4	20	4	20
Age	7.1	42.1	4.7	43
Intraop. blood loss (UPCs)	5	17	4	17.5
ReTx	1	2	0	4
V–V bypass	3	18	3	20
Hep. artery thrombosis	1	0	0	1
Portal v. thrombosis	0	0	0	2
Biliary stricture	0	3	1	0
Biliary leak	0	0	0	0

left and middle veins were joined in three cases, and the right and middle veins were used in two cases.

If difficulty was encountered in dissecting the hepatic veins, an alternative technique was used in which the liver was split, thereby opening the liver like a book and allowing the hepatic veins to be controlled from inside (Figs. 6 and 7). The principle of intraparenchymal exposure has been described previously for transplantation[5] and for major hepatic resections.[6] A tributary free plane is identified at the upper portion of the liver, and with gentle blunt dissection the finger is burrowed down the anterior surface of the vena cava. The liver is divided down to the finger (Fig. 6). Under direct vision it is then possible to see, ligate, or clamp the hepatic vein branches passing to the vena cava (Fig. 7).

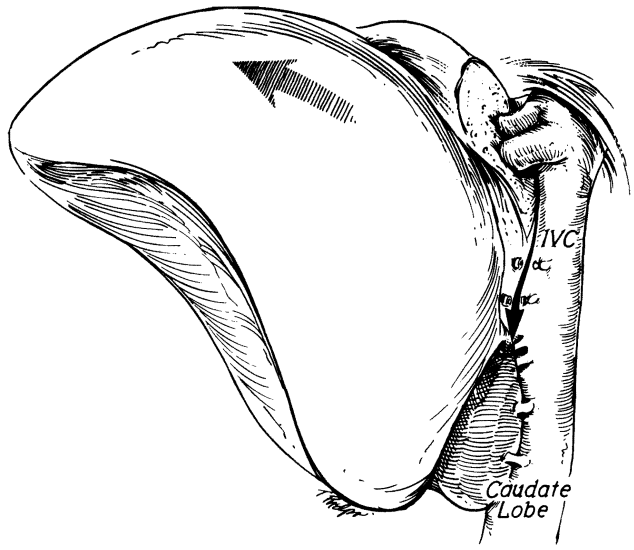

FIG. 2. The left lobe is rotated and individual hepatic veins are ligated. The major hepatic veins are exposed.

The technique of liver insertion is similar to the standard method, except for the outflow anastomosis, which is made to the anterior or anterolateral surface of the host vena cava. The exact location of this anastomosis depends on which of the major hepatic veins have been used. The lower end of the inferior vena cava of the homograft is either ligated or sutured (Fig. 8).

Retransplantation became necessary in three of the 24

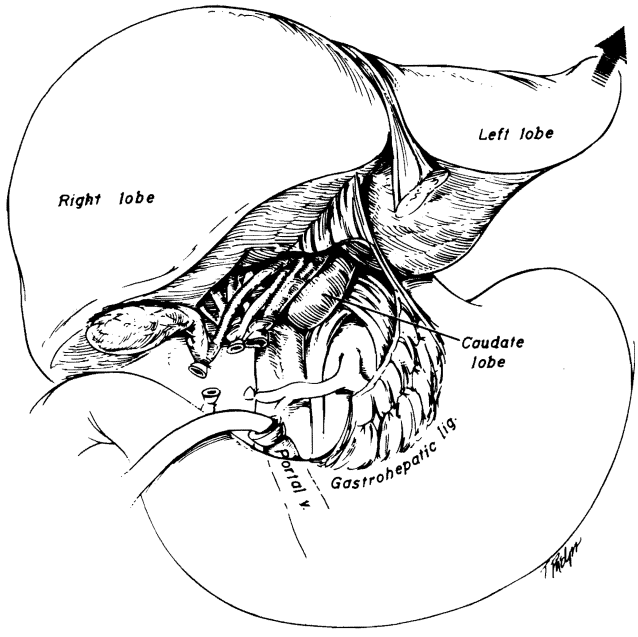

FIG. 1. The hilar structures are dissected, ligated, and divided. The portal vein is cannulated for the veno-venous bypass.

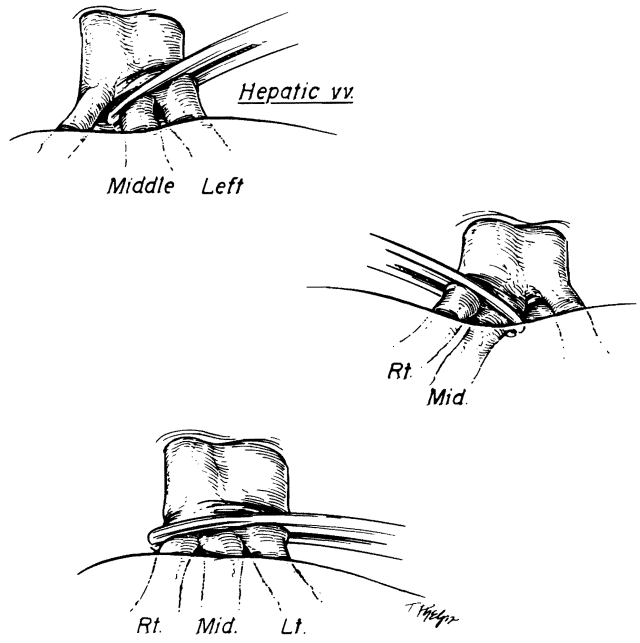

FIG. 3. The major hepatic veins are crossclamped.

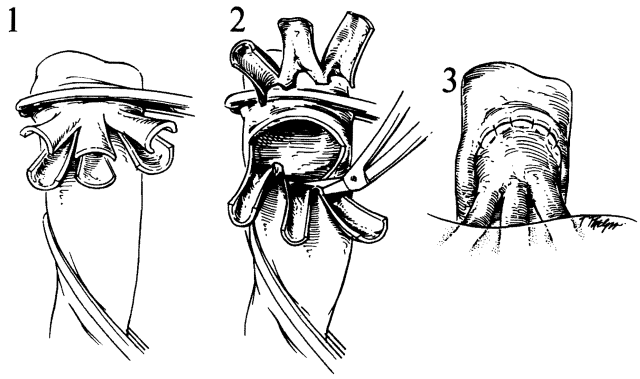

FIG. 4. Cuffs are fashioned for the outflow anastomosis.

recipients of piggyback livers, and the repeat operation was unusually easy because of the ability to reuse the outflow vena cava of the original homograft (Fig. 9).

Veno-venous bypasses of both the vena caval and portal systems were used for all of the adult recipients of the piggyback livers. In the adult patients the cuffs fashioned from the hepatic veins sometimes were prepared in a bloodless field with a clamp below this site. With the children a special attempt was made to maintain flow in the vena cava as dissection of the hepatic veins was taking place and during the anastomosis.

Results

There was a very high rate of success in both the piggyback and control groups with more than 90% of all patients surviving for at least 3 months (Table 1). There was no

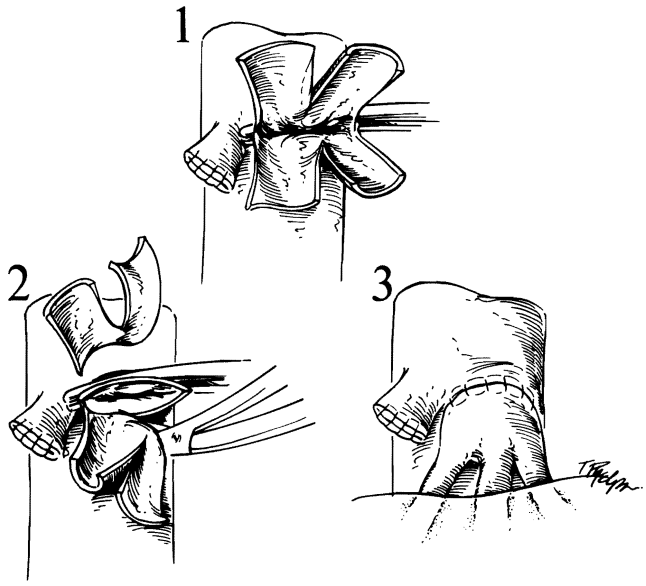

FIG. 5. Cuffs are fashioned for the outflow anastomosis.

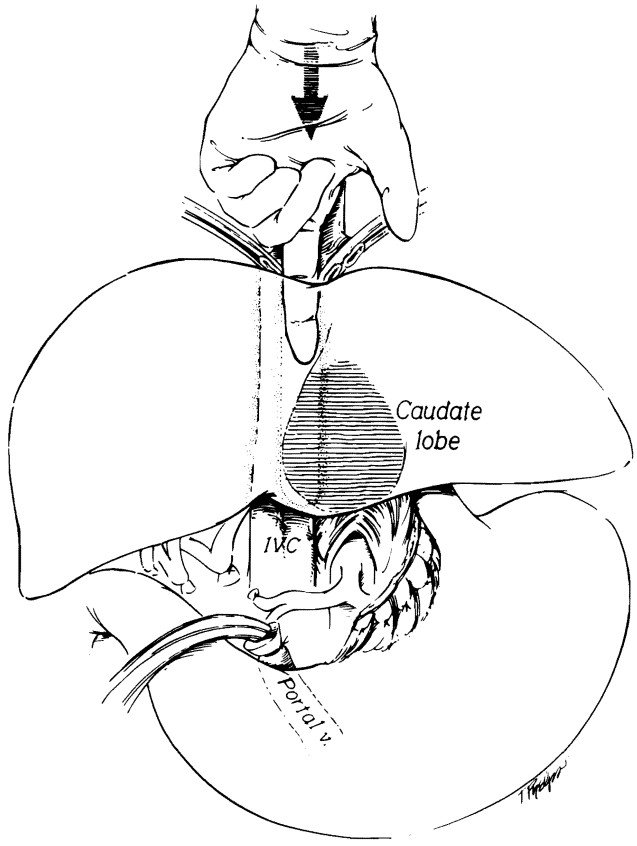

FIG. 6. A plane is developed on the anterior surface of the vena cava.

significant differences between the two groups in blood loss, retransplantation rate, portal vein or hepatic artery thrombosis, or biliary tract complications.

In one piggyback recipient, a thrombus was identified with ultrasonography 1 week after transplantation in the donor inferior vena caval stump. Anticoagulant therapy was not given. The thrombus could not be identified 1 month later with repeat ultrasonography. There was no evidence of pulmonary embolus in this or any other patient.

Discussion

The use of the piggyback technique depends on finding favorable anatomic conditions as the recipient hepatectomy proceeds. The least favorable circumstances tend to be with small cirrhotic livers, whereas the most favorable are with large livers in diseases such as primary biliary cirrhosis or sclerosing cholangitis in which the large hepatic veins are relatively normal and accessible. Patients with liver malignancies should not be considered because the tumor margin may be jeopardized. Children with biliary atresia have suitable anatomy for the piggyback procedure in at least one half of the cases. The ease of performance is the best guideline in deciding whether to at-

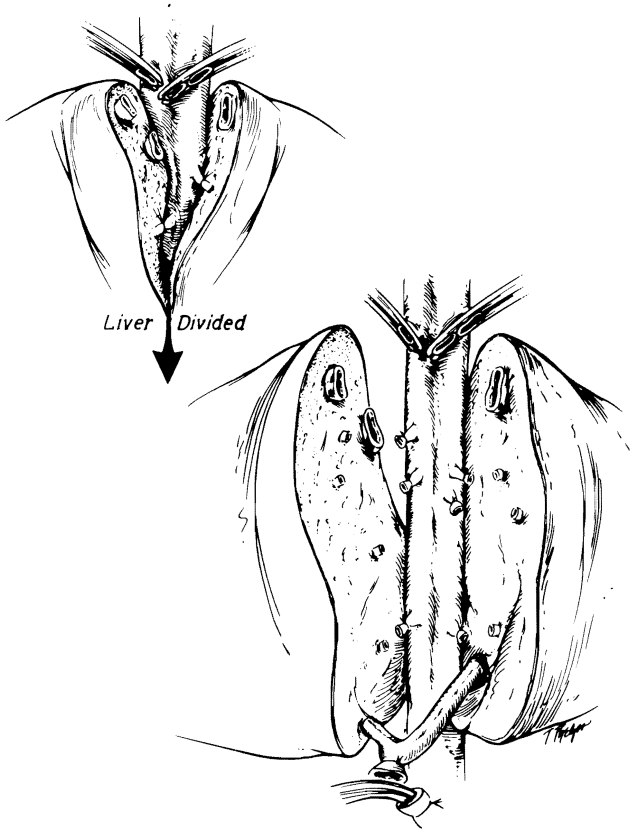

FIG. 7. Intraparenchymal exposure of the hepatic veins.

tempt this operation rather than the standard one. If difficulties are encountered, it is best to abandon the piggyback operation and remove the vena caval segment.

However the piggyback operation has very significant advantages for patients who have suitable anatomy. The physiologic disturbance can be minimized if the vena caval circulation is not occluded in the anhepatic period, especially in children in whom a bypass is not used. In either children or adults, less raw surface is created, thus making subsequent hemostasis easier. The technique of splitting the liver down to the vena cava can be life saving, even if the retrohepatic vena cava is not spared. In some patients the liver may be frozen into the hepatic fossa by previous operations to the extent that it cannot be safely mobilized and removed by any other expedient.

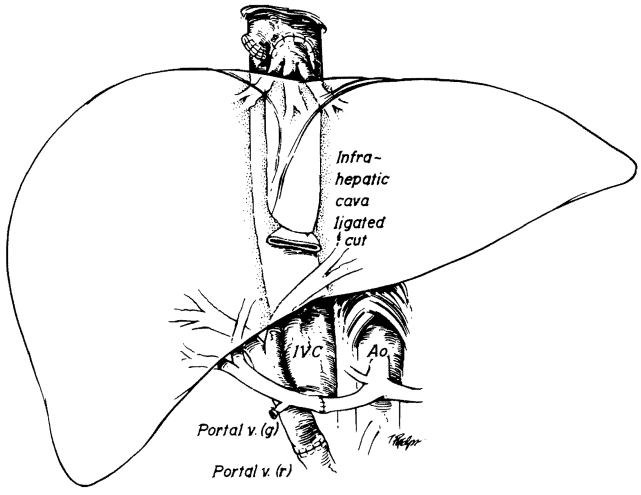

FIG. 8. The final appearance of the graft.

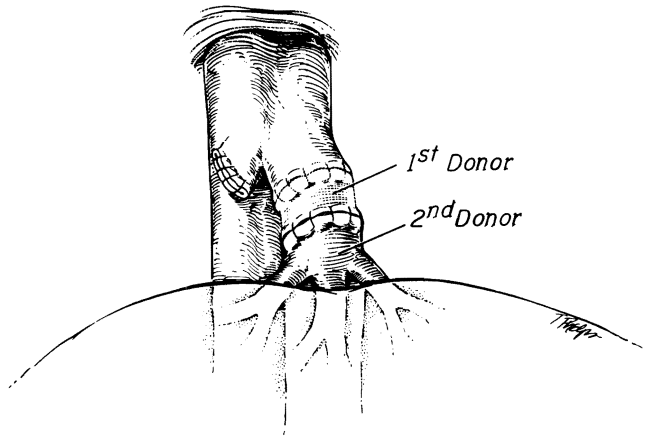

FIG. 9. Retransplantation: a rim of the suprahepatic cava of the original graft is retained.

A strong argument for the piggyback operation can be made in only a minority of cases, the 19% incidence during the period of the present study probably being a realistic projection. The piggyback technique may have special value if a liver from a substantially smaller donor is to be transplanted because it may be easier to adjust disparities in length of the donor and recipient vessels. Also for the transplantation of lobar or segmental fragments, the placement of these partial livers with a piggyback technique can provide greater versatility than the standard orthotopic approach can.

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