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Side-to-side cavo-cavostomy: a useful aid in "complicated" piggy-back liver transplantation

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Abstract. Piggy-back liver transplantation is a useful technical variant of orthotopic liver transplantation. Its success can, however, be compromised by severe stenosis or obstruction of the recipient's inferior vena cava at the level of the anastomosis. A technique is described – side-to-side cavocavostomy – to resolve this difficult intraoperative situation.

Key words: Liver transplantation – Caval anastomosis, liver transplantation – Piggy-back liver transplantation

Introduction

Since its original description by Starzl [7], liver allograft implantation has undergone several technical modifications. Past experience with liver transplantation in children with biliary atresia prompted the use of the piggy-back (PB) implantation procedure [4]. Indeed, the presence in young children of a complete, extrahepatic inferior vena cava (IVC) and of a long, common, extrahepatic venous channel including all hepatic veins has made it possible to successfully transplant a liver by only anastomosing the suprahepatic vena cava cuff to the joint orifices of the hepatic veins [6]. Broader experience with liver transplantation has led to the more frequent application of the PB procedure [3], even in adults in whom right, middle, and left hepatic veins separately join the IVC [4, 5, 8]. A more precise dissection of the recipient IVC results in reduced blood loss. Moreover, this method often allows transplantation to be performed without using venovenous bypass (VVB) [1].

A drawback of this technique may be hepatic venous outflow obstruction as a consequence of stenosis of a caval anastomosis. Isolated obstruction of the recipient IVC can also be a rare complication of this operation.

Case report

A 42-year-old woman underwent a liver transplantation for end-stage cryptogenic cirrhosis. The retrohepatic vena cava was separated from the liver by ligature and clipping of caudate hepatic veins. The IVC was then occluded with two clamps, below the diaphragm and above the right adrenal vein, and the liver was removed by transecting the hepatic veins. The right hepatic vein was distant from the common orifice of the middle and left hepatic veins.

Joining the two orifices together resulted in a wide orifice in the anterior wall of the remaining retrohepatic vena cava. As initially planned, a PB implantation was performed. The end-to-side anastomosis between the donor and recipient caval veins was performed using the intraluminal suturing technique [7].

Removal of clamps after completion of the anastomosis of the portal vein resulted in prompt and homogeneous revascularization of the graft. Precise control of the retrohepatic space, however, showed marked distension of the recipient IVC below the

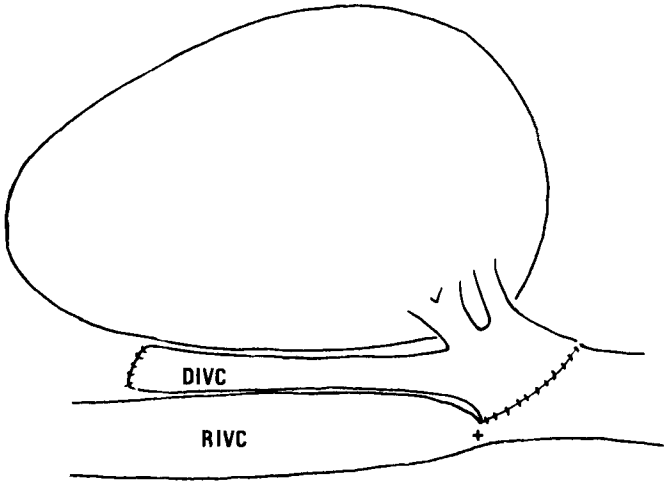

Fig. 1. Piggy-back liver transplantation complicated by stenosis (+) of the recipient's inferior vena cava *(RIVC)*. *DIVC*, Donor's inferior vena cava

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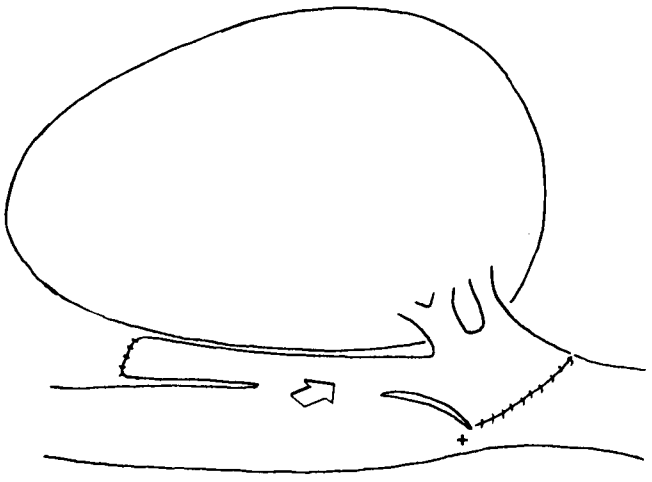

Fig. 2. The caval stenosis (+) is bypassed *(arrow)* by side-to-side cavocavostomy

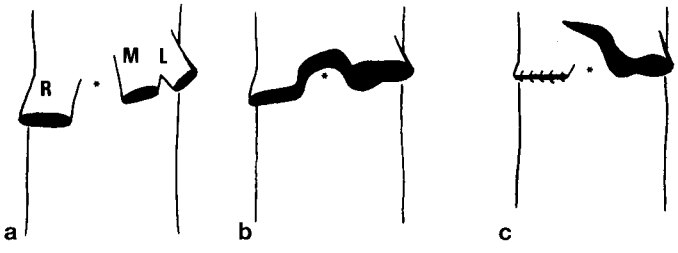

Fig. 3. **a** Anatomical situation of the orifices of the middle *(M)* and left *(L)* hepatic veins and of the right *(R)* hepatic vein, separated by thin-walled anterior vena cava (*). **b** Joining the middle and left hepatic veins with the right hepatic vein results in a large orifice, including thin-walled anterior vena cava (*). **c** The orifice of left and middle hepatic veins is enlarged in an upward and right direction to a predetermined size. Subsequent anastomosis to a solid part of the recipient IVC is possible. Right hepatic vein is closed by running suture

anastomosis. The end-to-side cavocaval anastomosis was patent but the recipient retrohepatic vena cava was stenosed at this level (Fig. 1).

This problem was resolved by performing a wide side-to-side anastomosis between both retrohepatic caval veins of the recipient and the donor (Fig. 2). Both veins were clamped tangentially, incised longitudinally over a distance of 2.5 cm, and anastomosed with continuous 4/0 prolene suture. This anastomosis was performed easily and completely eliminated the distension of the recipient IVC.

The patient's postoperative course was uncomplicated. The patient is now doing well, more than 4 years after transplantation. Repeated duplex Doppler ultrasound studies have shown perfect permeability of the side-to-side cavocavostomy, without any sign of caval obstruction.

Discussion

Morbidity and mortality following liver transplantation are mainly due to severe perioperative hemorrhage. All descriptions of PB liver implantation methods have one common feature, namely, careful disconnection of the recipient liver and retrohepatic vena cava, avoiding severe retroperitoneal and adrenal venous bleeding.

If the size of the suprahepatic vena cava cuff of the donor is similar to the joint orifices of the left and middle hepatic veins of the recipient, a direct end-to-end anastomosis can easily be performed. If the suprahepatic vena cava cuff of the donor is too large, the anastomosis is usually done to the recipent's joined orifices of all three hepatic veins.

The right, left, and middle hepatic veins are, however, not disposed in the same anatomical plane. Indeed, the right hepatic vein is located at the right lateral side of the IVC and somewhat lower than the confluence of left and middle hepatic veins (Fig. 3a). Joining these orifices therefore involves incision of the anterior wall of the vena cava. The caval wall between the left and middle hepatic veins and the right hepatic vein is particularly thin and frail (Fig. 3b). It is therefore sometimes necessary to include more venous wall in the suture of the posterior layer of the cavocaval anastomosis in order to obtain a safe anastomosis. This explains the resulting stenosis of the donor's vena cava in our case. The problem was easily circumvented by side-to-side cavocavostomy, allowing the recipient's stenosed IVC to drain into the patent donor's retrohepatic vena cava. Side-to-side cavocavostomy can be done under tangential clamping of the donor and recipient IVC without interrupting hepatic venous flow or retrohepatic caval flow. The effectiveness of such an anastomosis has recently been demonstrated in two other variations of the PB procedure. Bismuth et al. described a face-à-face vena cava plasty to overcome major discongruence when transplanting a small liver into an adult [2]. Belghiti's group routinely uses side-to-side cavocavostomy in adult PB liver transplantation, respecting caval outflow during the anhepatic phase. This technique reduces the indication for venous bypass [1].

Stenosis of the recipient IVC, as reported in our case, can be prevented by modification of the liver implantation in PB transplantation. When the common orifice of the left and middle hepatic veins is too small for direct anastomosis with the donor's vena cava cuff, we now suture the right hepatic vein and enlarge the common orifice of the left and middle hepatic veins by an incision in the anterior wall of the vena cava in an upward and right direction, tailoring its size to the dimensions of the donor vena cava (Fig. 3c). Anastomosis is then performed at a distance from the thin-walled area of the vena cava. This small technical modification prevents caval stenosis by allowing anastomosis with optimal matching of size and wall thickness. As an alternative, both extremities of the donor retrohepatic vena cava could be sutured and a side-to-side cavocavostomy performed [1].

The complication reported here has been corrected by side-to-side cavocavostomy. Further development of this concept, as reported in two recent publications [1, 2], might influence the technique of orthotopic liver transplantation in the future.

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