Direct Bile Duct Visualization During the Preparation of Split Livers

Silvio Balzan, Olivier Farges, Daniele Sommacale, Federica Dondero, Maryléne Plasse, and Jacques Belghiti

The split-liver technique is an important means to alleviating donor shortage. Its development is, at least in part, hindered by the risk of biliary complications, particularly when splitting is performed *ex situ*. We present a simple technique aimed at improving the identification of the biliary anatomy at the hilar level and the safety of the procedure. (*Liver Transpl 2004;10:703–705.*)

Split-liver grafting accounts for a minority of transplantations, and the use of this technique has not increased significantly over the past 5 years in Europe[1] or the United States,[2] despite patient and graft survival rates comparable to those for whole-organ transplantation.[3,4,5] Besides difficulty organizing this procedure,[6] other limitations to split-liver transplantation include the additional time required to prepare the graft, prolonged ischemia, and technical difficulties that result in an increased incidence of biliary complications in some series.[4,7] Biliary complications can be related to biliary ischemia if an extensive hilar dissection is performed to identify the left and right bile ducts. Alternatively, blind dissection may result in the transaction of multiple ducts and hence in multiple biliary anastomosis. Methylene blue is a nontoxic dye that has been used in liver resection surgery to identify biliary leaks. We have found that this dye could be used to visualize bile ducts during the *ex situ* preparation of split-liver grafts and hence help determine the level of biliary bipartition without extensive dissection.

Methods

The whole organ is retrieved and preserved with Wisconsin solution (Bristol Myers Squibb, Bruxelles, Belgium) according to standard techniques of multiple organ procurement. The partition is performed in an ice bath of the same solution. Before dissection, a cholangiography is performed by injection of pure contrast medium through the distal bile duct to identify major anatomical variations. The biliary tree is thereafter washed with preservation solution. No angiography was performed in this series.

The parenchyma transection is subsequently performed along the main portal scissura or umbilical fissure prior to any hilar or pedicular dissection, using an ultrasonic dissector (Dissectron, Satelec, France Medical, Paris) with clips and/or sutures. This division is performed down to the hilar plate, which is exposed but neither dissected nor encircled. Methylene blue (Byam, Paris, France), diluted 1/10 in saline, is injected through the distal bile duct (approximately 20cc) to visualize the biliary branches, and the hilar plate is transected accordingly, without previous dissection of arterial or portal vessels. Generally the common bile duct is left with the right graft, especially when a right liver sector is drained into the left duct. Dissection of the arterial and portal branches is kept to a minimum to avoid biliary ischemia.

Results

This technique was used in 7 *ex situ* split-liver transplantations and 7 living-related donor hepatectomies. Clear visualization of large and small bile ducts within the hilar plate was achieved in all cases of *ex situ* splitting. Segment 1 bile ducts in particular were easily visualized (Fig. 1). Except for 1 case, all segment 1 branches could be preserved within one or the other graft. A single biliary orifice was obtained in each of the 14 grafts. A biliary leak developed postoperatively in a single recipient and healed spontaneously. There was no evidence of biliary stenosis. The time required for liver partition using this technique was 55 $\pm$ 15 (mean $\pm$ SD) minutes, compared with 70 $\pm$ 15 (mean plusmn; SD) minutes for the 5 splits performed before the introduction of this new method ($P < 0.05$). In contrast, the procedure was less effective during living-related donor hepatectomies with poor visualization of the biliary ducts following injection of methylene blue.

Discussion

Biliary complications have long been recognized as a significant problem in split-liver transplantation.

From the Hepatobiliary Service and Department of Digestive Surgery, Beaujon Hospital, Clichy, France.

Address reprint requests to Jacques Belghiti, MD, Department of Digestive Surgery, Hospital Beaujon, 100, Boulevard du General Leclerc, 92118 Clichy Cedex, France. Fax: 33 1 408 71 724; E-mail: jacques.belghiti@bjn.ap-hop-paris.fr

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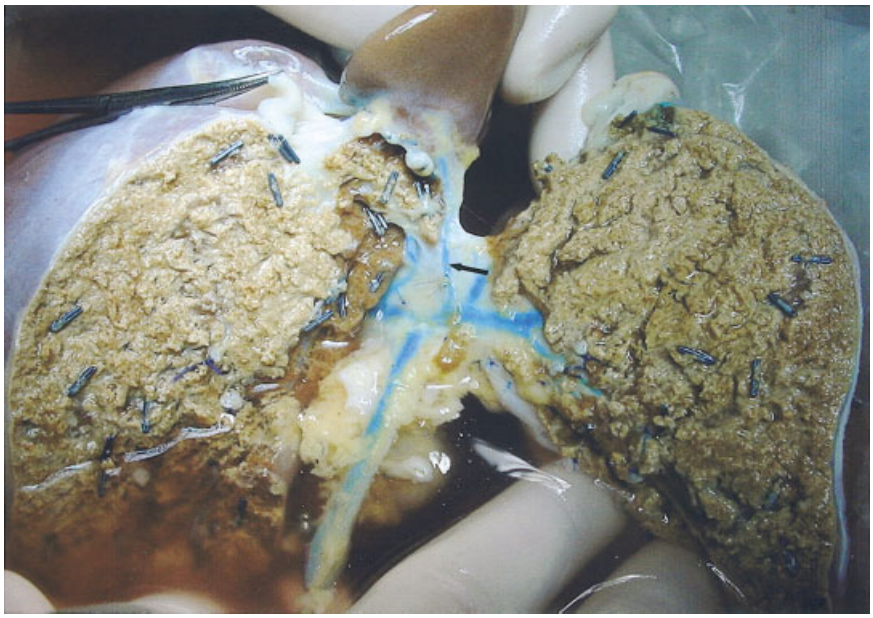

Figure 1. Aspect of the hilar biliary anatomy after methylene blue injection in the main biliary duct. The parenchyma section is completed, and the ideal site to cut the biliary duct can be easily identified. The arrow indicates a biliary duct of segment 1, difficult to visualize without the presented technique.

Although expert teams have reported low biliary complications rates of approximately 10%,[8–11] especially when splitting is performed *in situ,* others have experienced rates as high as 25%.[3,12] Two factors have been implicated in the incidence of biliary complications: (1) the ischemia of the biliary ducts, due to an excessive dissection during bench surgery, and (2) the presence of a variant biliary anatomy, engendering two or more biliary branches at the level of section that complicates the recipient's procedure. Both factors appear intricate in the usual techniques of *ex situ* splitting. Traditionally,[3] the procedure starts with a relatively extensive hilar dissection to identify anatomic variations. In fact, the biliary confluence is relatively hidden within the hilar plate. This approach, however, interrupts the collateral arterial circulation within the hilar plate and may result in devascularized bile ducts ends. Moreover, attempts at encircling the bile duct at the biliary confluence may result in inadvertent injuries to small biliary branches to segment 1 or 4. Another approach, described by Rogiers et al.,[4] is to perform a blind section of the bile duct prior to liver transection. Although this leads to a lower incidence of biliary complications, it may also result in a higher incidence of grafts with multiple biliary openings.[4]

The approach described in the present study is original in two aspects: (1) The parenchymal transection is performed first, prior to any hilar dissection; and (2) the bile ducts within the exposed hilar plate are made easily identifiable by injection of methylene blue. Exposure of the hilar plate does not in itself result in devascularization of the bile ducts, as a rich collateral arterial supply is present within the hilar plate. In addition, we have found this technique to significantly reduce the time required for preparing both grafts and hence reduce ischemia time. In contrast, the results were much less satisfactory for living-related donors, probably because of the persistence of blood-filled vessels within the hilar plate.

In conclusion, the present technique of parenchymal transection prior to bile duct division is derived from our experience with *in situ* splitting and living-related liver transplantations. It is a simple and effective technique for the safe identification of biliary anatomy during *ex situ* splitting that allows direct visualization of the optimal site of biliary tract division without extensive dissection and related lesions of accessory branches near the hilar plate. We hope that this technique may be helpful to others, and we encourage new centers that are less familiar with this technique to develop split-liver transplantation more confidently.

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