

HOW I DO IT

Resection and Reconstruction of Retrohepatic Vena Cava Without Venous Graft During Major Hepatectomies

MARCEL AUTRAN C. MACHADO, MD,* PAULO HERMAN, MD,
TELESFORO BACCHELLA, MD, AND MARCEL C.C. MACHADO, MD, FACS
Department of Gastroenterology, University of São Paulo, São Paulo, Brazil

Background: Progress in liver surgery has enabled hepatectomy with concomitant venous resection for liver malignancies involving the inferior vena cava (IVC). The authors describe an alternative technique for IVC reconstruction without the need of graft.

Methods: Parenchymal transection is performed from anterior surface of the liver down to the anterior or left lateral surface of the IVC using combination of two techniques reported elsewhere. IVC is clamped above and below the tumor and the liver in continuity with an invaded segment of IVC is removed en bloc. A transverse anastomosis of IVC is performed starting with running suture on the posterior wall followed by the anterior wall.

Results: This approach has been successfully employed in eight consecutive patients with IVC involvement. The procedures performed were 5 right hepatectomies, 1 right posterior sectionectomy, 1 right trisectionectomy, and 1 left trisectionectomy. Two patients needed total vascular exclusion (TVE) for 11 and 10 min, respectively. Blood transfusion was necessary in three patients. Pathologic surgical margins were free in all cases. No postoperative mortality was observed.

Conclusion: This technique of IVC reconstruction precludes the use of graft and minimizes the use of TVE decreasing ischemic damage to the remnant liver.

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KEY WORDS: liver; inferior vena cava; technique; anatomy; hepatectomy

INTRODUCTION

Until last decade, liver tumor with concomitant venous involvement has been considered a contraindication for liver resection. Recently, progress in liver surgical techniques allows resection in selected patients with liver malignancies involving the inferior vena cava (IVC) [1–7]. In patients with liver tumors and retrohepatic vena cava invasion, the usual approach is to perform a posterior and lateral dissection of the IVC after the complete mobilization of right liver. Another option is to perform a liver hanging maneuver [8] with exposure of the IVC anterior aspect. However, when tumor invades IVC anterior aspect those techniques are not suitable

when the retrohepatic avascular plane anterior to the IVC surface is occupied by the tumor. In this situation, the surgeon is not capable to encompass the IVC with the postero-lateral approach and total vascular occlusion [9] becomes mandatory.

The authors report their experience with IVC resection and reconstruction during major hepatectomies and

*Correspondence to: Marcel Autran C. Machado, MD, Rua Evangelista Rodrigues 407-05463-000, São Paulo, Brazil.

Fax: 55-11-3285-2640. E-mail: dr@drmarcel.com.br

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describe an alternative method for reconstruction without venous graft.

TECHNIQUE

A bilateral subcostal incision extended superiorly in the midline to the xyphoid or a J-shaped incision is performed. In cases with large right lobe tumors, no prior mobilization is performed; otherwise right liver is mobilized by sectioning falciform, right triangular and coronary ligaments. Whenever possible the right lobe is completely freed and all tributaries veins between the liver and IVC are suture-ligated except those with close contact with the tumor. In patients with tumors on the left liver the IVC invasion usually occurs when the caudate lobe is occupied by the tumor.

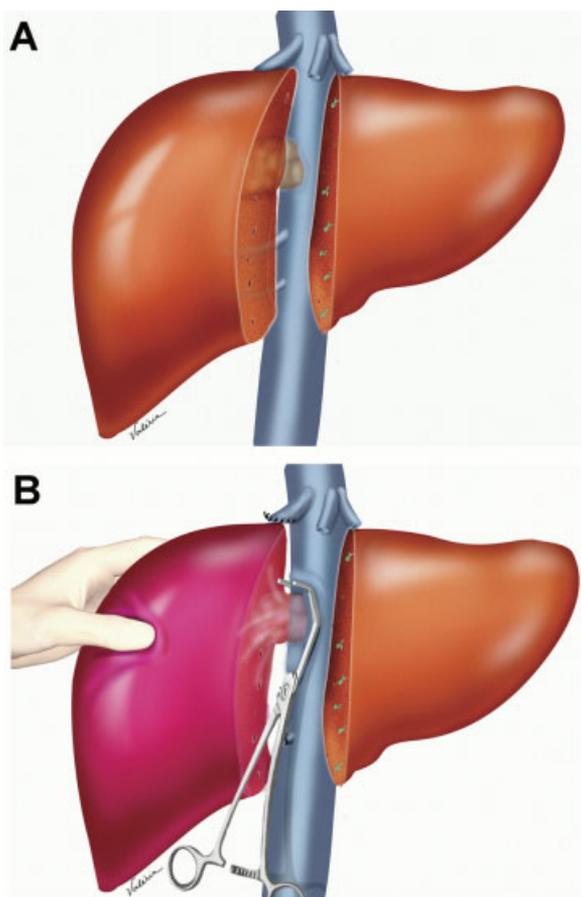


Fig. 1. Approach for retrohepatic inferior vena cava exposure and resection during right hepatectomy (adapted from Liu et al. [11] and Hemming et al. [7]). **A:** Transection of the liver parenchyma until complete exposure of retrohepatic inferior vena cava. **B:** Right hepatic vein and venous branches are suture-ligated. The application of vascular clamp is the final step before removal of surgical specimen. The surgeon can easily insert the vascular clamp and therefore obtain good surgical margins. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

Intraoperative ultrasound is performed routinely and is useful to identify the extension of the IVC invasion.

Right Liver Tumors

Main right portal pedicle is encircled using intrahepatic glissonian approach [10] and cross-clamped and ischemic delineation of the right liver is obtained. The plane of parenchymal transection is marked on the liver capsule and the transection is performed from anterior surface of the liver down to the anterior or left lateral surface of the IVC using combination of two techniques reported elsewhere [7,11] (Fig. 1A). The exact plane of transection will depend upon the position of the vena cava invasion. In cases of lateral invasion, the anterior surface is completely exposed but if an anterior invasion is seen, the line of parenchymal transection is towards the IVC

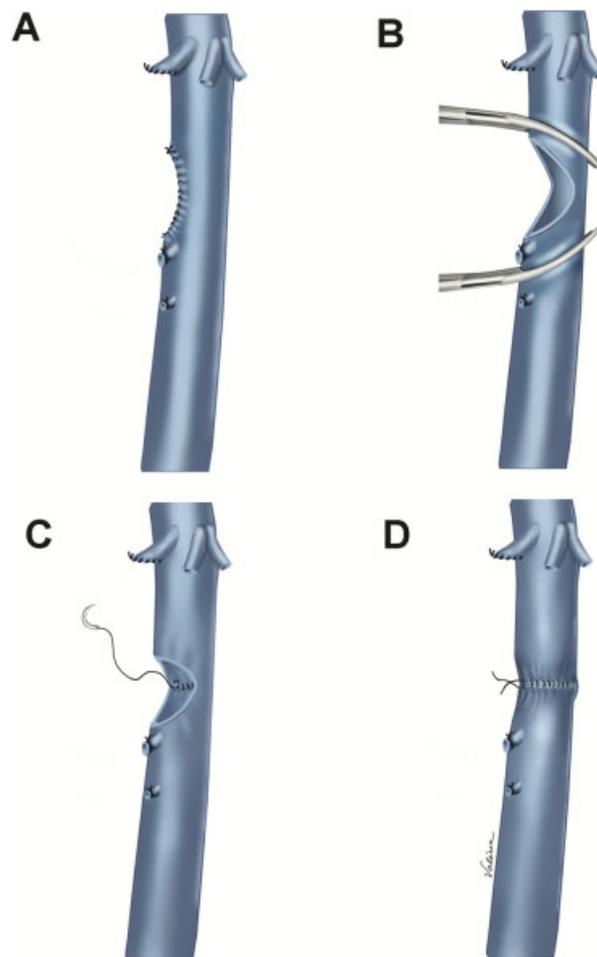


Fig. 2. Techniques of inferior vena cava reconstruction. **A:** Lateral venorrhaphy. A running suture can be used when the circumferential invasion of the IVC is less than one third. It is simple, fast, and precludes caval exclusion. **B:** When circumferential invasion larger than one third, caval exclusion is mandatory. **C:** For reconstruction of IVC without use of graft, a transversal anastomosis can be performed. **D:** Final aspect of IVC reconstruction. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

left side. The right hepatic vein is isolated, and suture-ligated, and the invaded vena cava is then dissected away from the tumor in order to obtain clear surgical margins and a vascular clamp is applied (Fig. 1B); the IVC is then divided and the specimen removed. The reconstruction of the IVC will depend on the extension of vascular tissue removed and can be done in two different ways without the need of a graft (Fig. 2). If vein involvement is inferior to a third of its circumference, it can be reconstructed by a lateral venorrhaphy running suture (Fig. 2A). Otherwise, the IVC is clamped above and below the tumor and the right lobe of the liver in continuity with an invaded segment of IVC is removed en bloc (Fig. 2B). A transverse anastomosis of the IVC is performed starting with 4.0 prolene running suture on the posterior wall followed by the anterior wall as shown in Figure 2C,D, and the vascular clamps are then removed.

Left Liver Tumors

The same technique can be used for left liver tumors with IVC invasion. Main left portal pedicle is encircled

and cross-clamped resulting in ischemic delineation of the left liver [12]. The plane of parenchymal transection is marked on the liver capsule and the transection is performed from anterior surface of the liver down to the anterior or right lateral surface of the IVC in the same way as for right liver resection. All hepatic veins from the caudate lobe are suture-ligated except those near the tumor. The middle and left hepatic veins are isolated, and suture-ligated, and the invaded vena cava is then dissected away from the tumor in order to obtain clear surgical margins and a vascular clamp is applied; the IVC is then divided and the specimen removed. The reconstruction of the IVC is performed in the same fashion as described for right liver tumors.

RESULTS

This technique has been successfully employed in eight consecutive patients with IVC malignant involvement (Fig. 3). There were 5 women and 3 men, mean age 59 years. Seven patients underwent liver resection for colorectal liver metastasis and one intrahepatic

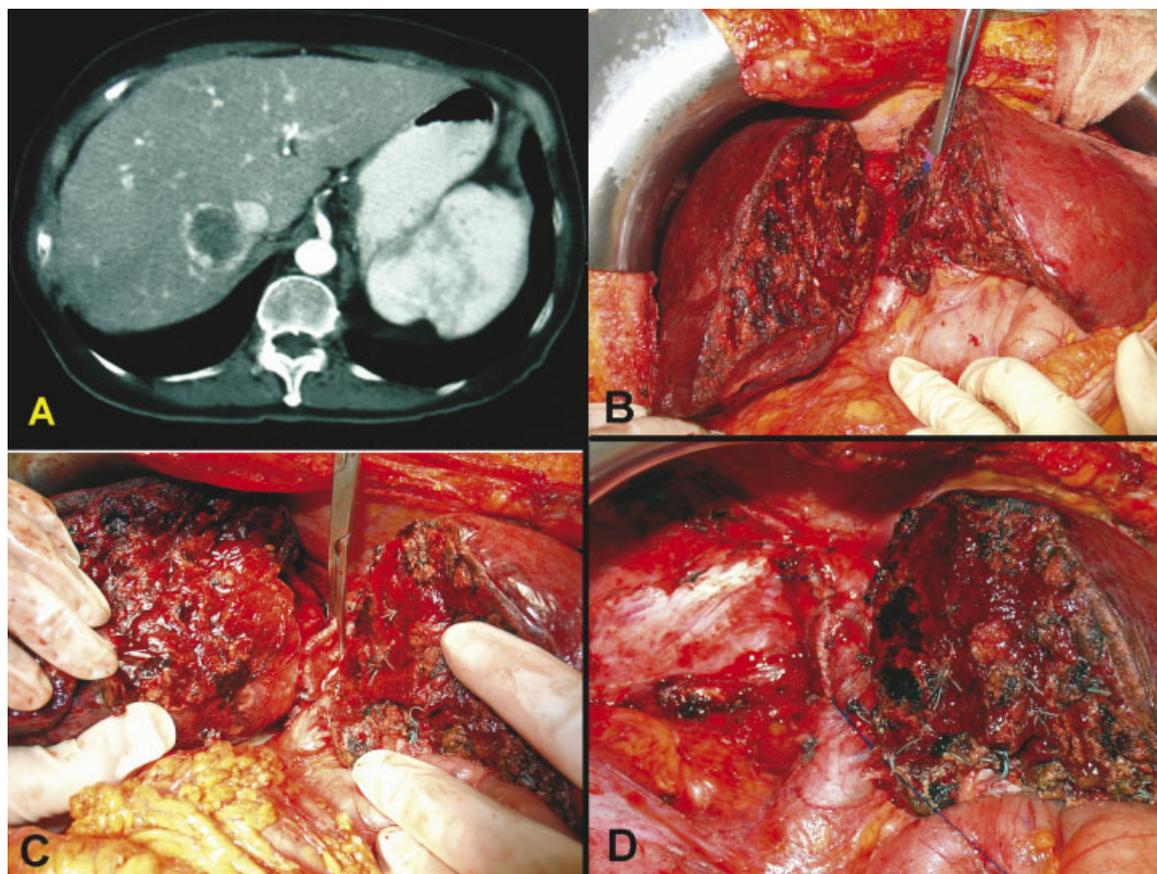


Fig. 3. Clinical case of IVC resection and reconstruction during right hepatectomy. **A:** Preoperative CT scan shows a tumor invading IVC. **B:** Intraoperative view after liver transection and exposure of retrohepatic IVC. **C:** Vascular clamp is applied right before removal of surgical specimen. **D:** Intraoperative view of the liver after right hepatectomy with resection and reconstruction of IVC. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

cholangiocarcinoma. The procedures performed were 5 right hepatectomies, 1 right posterior sectionectomy, 1 right trisectionectomy, and 1 left trisectionectomy. Two patients needed total vascular exclusion (TVE) for 10 and 11 min, respectively, and remained hemodynamically stable. Blood transfusion was necessary in three patients (mean 3 U). Pathologic surgical margins were free in all cases. Mean hospital stay was 7 days. One patient developed deep vein thrombosis that was treated with anticoagulants. No postoperative mortality was observed.

DISCUSSION

Despite recent reports on the satisfactory outcomes of hepatectomy for liver tumors, hepatic resection for tumors invading IVC remains a major surgical challenge. Involvement of the hepatocaval confluence or IVC was long considered a contraindication for liver resection, due to the risks of gas embolism and massive bleeding. Recently, en bloc resection of hepatic malignancies invading the IVC has become technically feasible and relatively safe in expert hands [13,14]. Although partial IVC resection during hepatectomies is increasingly used in some centers, few comprehensive descriptions of the technical aspect of the reconstruction are available [14].

The presence of IVC invasion is often difficult to determine reliably, and imaging modalities are inaccurate to differentiate malignant infiltration of the IVC wall from simple tumoral adhesion to the vein. Even when IVC invasion is strongly suggested by radiological studies such as computed tomography, magnetic resonance imaging, or cavography, the surgeon should attempt to peel the tumor from the IVC in order to avoid its unnecessary resection [13]. The decision to resect the IVC is often taken during the procedure, and on occasion, resected specimens show no caval invasion upon pathology examination [15].

Allografts, autologous graft [4], Dacron or PTFE [2,3] have been used to replace resected segments of IVC and, in many centers a vascular surgeon may be called to perform the reconstruction of the IVC. In the present series, the reconstruction of the IVC was possible in all cases without use of a graft.

This approach is useful in a number of clinical situations. At the end of the procedure the remnant liver is well perfused with good hepatic vein drainage and with complete exposure of the IVC. In this setting, the surgeon can choose the best technique for resection and reconstruction of the hepatocaval junction.

We report our experience of IVC partial resection and reconstruction during major hepatectomies using differ-

ent possibilities of approach to IVC [7,8,11]. The main advantage of the described approach is the possibility to perform complete hepatic dissection before resection of IVC. Another advantage is to avoid bleeding that can occur if an attempt to IVC resection is performed early in the procedure. The reconstruction after IVC resection (wedge or segmental) is greatly facilitated by the previous removal of the surgical specimen. With this approach, IVC resection can be performed safely, with acceptable blood loss and good surgical margins.

We also describe an alternative technique for IVC reconstruction using transverse suture. This technique of IVC reconstruction precludes the use of autologous or synthetic graft.

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