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Repeated hepatic resection combined with inferior vena cava replacement: Case report and review of literature

Gian Piero Guerrini*, Paolo Soliani

Ravenna Hospital, AUSL Romagna, HBP and General Surgery Unit, Randi 5, 48121 Ravenna, Italy

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ABSTRACT

INTRODUCTION: Advanced tumors of the liver involving the inferior vena cava (IVC) have always been considered a contraindication to surgery.
PRESENTATION OF CASE: We report a case of a patient, who previously underwent right hepatectomy, with recurrence of colorectal liver metastasis invading the IVC. The patient had a liver resection together with replacement of the vena cava using a ringed polytetrafluoroethylene (PTFE) graft tube. The operation was carried out in hepatic vascular exclusion (HVE) without the use of veno-venous bypass. The patient was healthy and tumor-free at 6 months post-surgery.
DISCUSSION: In patients with hepatic malignancy involving the IVC, extended hepatic resection and reconstruction of the IVC is often the prerequisite to obtaining a resection margin.
CONCLUSION: Extended hepatic resection with IVC reconstruction for hepatic malignancy may offer a chance of cure to selected patients who otherwise have poor survival rates.

1. Introduction

Hepatic resection is considered first-line therapy for many primary and metastatic liver tumors.[1] Thanks to a more careful perioperative management, the use of highly accurate preoperative imaging and the refinement of surgical techniques, hepatic resection has been applied more extensively and successfully. Post-operative mortality has currently been reduced to less than 5% in almost all groups, whereas 5-year survival after hepatic resection for colorectal metastases, primary tumors or other types of non-colorectal metastases has increased from 30 to 50%. In the past, patients with large tumors involving the inferior vena cava (IVC) were not considered candidates for surgical resection. However, these untreated patients had a poor survival rate, less than 12 months, even when using palliative chemotherapy.[2]

In recent years, the improvement of surgical techniques with a detailed increase in knowledge of the segmental anatomical structure of the liver has permitted liver resections that were until recently deemed high-risk surgery. Innovative and aggressive surgical techniques, principally derived from transplant surgery, such as hepatic vascular exclusion (HVE), veno-venous bypass and ex vivo hepatic resection, have been reported in dealing with hepatic tumors involving the IVC.[3,4] An ideal technique for reconstruction of the IVC has not yet been described. Graft prosthetics and autologous or synthetic patches are methods extensively mentioned in the literature for repair of the IVC.[5] This paper reports a case of vena cava and hepatic resection for malignant tumors.

2. Case report

In a woman of 67 years in follow-up at our clinic after right hepatectomy performed 3 years earlier, for colorectal hepatic metastasis, a new lesion was detected in the liver. Two years before the hepatic resection, the patient had been operated on laparoscopically for left colectomy for adenocarcinoma G2, T3, N1, M0 (according to TNM, sixth edition).

Quadriphase contrast-enhancement abdomen and chest computed tomography (CT) showed a hypodense lesion in liver segment IV, 4 cm in diameter, infiltrating the intrahepatic portion of the inferior vena cava. Prior to surgery the patient underwent magnetic resonance imaging (MRI) with vascular reconstruction in order to evaluate the relationship between the tumor, the vena cava and the hepatic veins in detail.

In addition, the patient underwent a stress echocardiogram so as to evaluate the heart function in view of a total hepatic vascular exclusion.

The access laparotomy consisted of a bilateral subcostal incision on the previous surgical scar. After extensive and laborious adhesiolysis, since part of the colon and small intestine completely occupied the right upper quadrant, it was possible to expose the liver. An intraoperative ultrasound scan (IOUS) confirmed the preoperative findings and excluded other metastases in liver

* Corresponding author. Tel.: ++39 3396284750; fax: +39 0544 2823665.
E-mail address: guerrinigp@yahoo.it (G.P. Guerrini).

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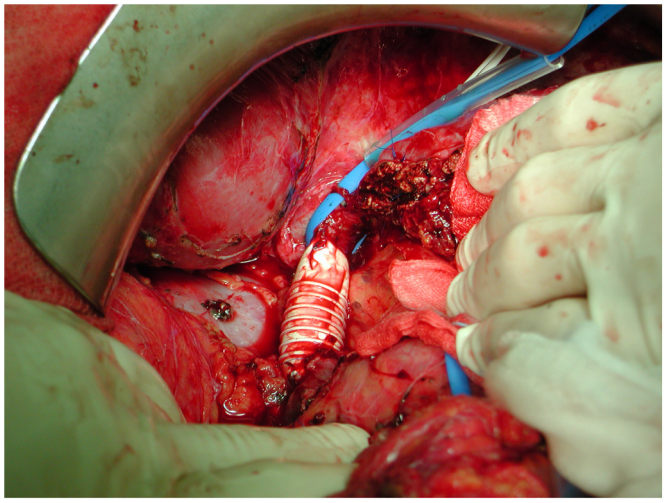

Fig. 1. Intraoperative field after hepatectomy and the reconstruction of the vena cava.

segments II–III. The operation began by exposing the inferior vena cava below the tumor and above the hepatic vein; both parts of the IVC were surrounded by vessel loops. The liver parenchyma was divided along the umbilical fissure (on the left side), by using bipolar forceps. Central venous pressure was constantly maintained at or below 5 cm of H_2O during the parenchymal transection to minimize the risk of bleeding. During the transection, non-selective portal clamping (Pringle maneuver) was applied for 12 min. We then proceeded with the placement of a vascular clamp on the infrahepatic vena cava and the other clamp on the suprahepatic vena cava (above the hepatic vein), completing the resection of segment IV associated with the excision of retrohepatic vena cava (Fig. 1). The caval reconstruction was via the interposition of a 20 mm ringed-PTFE tube graft, in total vascular exclusion for about 25 min. In the ICU, heparin iv anticoagulation was started, maintaining an activated partial thromboplastin time ratio (aPTT) of 2.5–3. On the fifth post-operative day, the infusion of IV heparin was stopped and changed to subcutaneous injection of low molecular weight heparin (enoxaparin); at the same time, we started the administration of antioral platelet drugs.

The postoperative period was characterized by no major surgical complications, although the patient developed right pleural effusion. Histopathological examination of the specimen indicated an R0 resection margin. The patient was discharged on the 29th postoperative day. Six months post-operatively, the patient is in good health and tumor-free.

3. Discussion

Hepatic resection for liver MTS has been shown to result in better prognosis than other treatments. Hepatic resection of tumors located in the middle of the liver and invading the IVC was considered until recently an absolute contraindication to surgery.

However, thanks to innovative techniques, these types of liver resections offer a chance of cure to patients who until recently were not considered candidates for any surgical treatment. The benefit of hepatic resection combined with resection and reconstruction of the vena cava is obvious, since it is an attempt to achieve oncological radicality, otherwise impossible.[6]

Recent papers have clarified the safety and advantages of combining excision of the IVC in continuity with hepatic resection for liver malignancy invading the IVC or hepatic vein.

Several surgical techniques are reported in the literature in dealing with tumors involving the IVC (Table 1). The type of surgical strategies that can be used depends on the extension of the tumor along the inferior vena cava.[7]

When the tumor invades a small portion of the IVC, it is possible to apply a clamp tangentially; in this case, the IVC can be repaired primarily with a venorraphy or with a patch in enlargement, provided that there is no excessive narrowing of the vascular lumen. Caval stenosis, in fact, causes persistent edema of the lower limbs and, in severe cases, renal dysfunction.[2]

In cases where tumor invasion is quite extensive, resection of the inferior vena cava requires the interruption of the caval flow. In this case, two different strategies can be used: when the involvement of the IVC is below the hepatic veins, then a clamp is placed above the tumor but below the outlet of the hepatic veins into the IVC

Table 1
Reported series of combined liver and IVC resections.[a]

Author	Patients	Vascular control	IVC reconstruction	R0 surgical margin	Complications Dindo > III	In hospital mortality	Overall survival
Malde et al.[9]	35 pt	TVE 15 In situ 14 Ex vivo 6	Graft tube 12 Direct repair 23	18 pt	14 pt	4 pt	5-years 19.6%
Nuzzo et al.[6]	23 pt	TVE 12 In situ 4 Other 7	Graft tube 7 Direct repair 16	23 pt	9 pt	1 pt	3-years 69%
Hashimoto et al.[13]	18 pt	TVE 1 Other 17	Direct 17 Graft tube 1	18 pt	–	–	5-years 46%
Azoulay et al.[10]	22 pt	TVE8 In situ9 Other 4	Graft tube 10 Direct repair 12	22 pt	14 pt	1 pt	5-yers 38.8%
Hemming et al.[3]	22 pt	TVE 11 In situ 1 Ex vivo 2 Other techniques 7	Graft tube 14 Direct repair 8	20 pt	10 pt	2 pt	5-yers 33%
Sarmiento et al.[12]	19 pt	TVE 13 Other techniques 6	Graft tube 18 Direct repair 1	16 pt	8 pt	1 pt	5-years 21%
Arii et al.[5]	11 pt	TVE 11	Graft tube 9 Direct repair 2	11 pt	2 pt	1 pt	5-years 25%
Miyazaki et al.[14]	16 pt	TVE 8 In situ 3 Side clamp 5	Graft tube 1 Direct repair 15	16 pt	4 pt	1 pt	5-years 22%

TVE: total vascular exclusion; hypothermic in situ and ex situ. Other techniques include: partial IVC clamping, side clamping. Repair: graft tube (ringed-graft tube), direct repair includes IVC repair directly or with patch.

[a] Series with less than three patients excluded.

(clamping of the intrahepatic cava) with the advantage of being able to maintain the blood flow from the liver to the heart while following resection and reconstruction of the IVC.[8]

When the clamp is placed on the cava above the hepatic veins, then total vascular exclusion (HVE) must be used. The latter can be performed with or without veno-venous bypass, depending on the hemodynamic stability of the patient. In this case, it is advisable to perform the vascular exclusion test in order to check the stability of the circulation and heart function; however, bypass is recommended in those patients with heart disease or kidney failure. It has been suggested, in cases of total vascular exclusion, to begin to minimize warm ischemia of the liver before the caval resection. In our case, a total vascular exclusion was achieved as not enough room was available to place the clamp below the outlet of the hepatic vein, since the tumor was close to the hepato-caval junction.

Normally, the liver can tolerate total ischemia for 60–90 min.[9] However, it is preferable to reduce this time to 60 min in cases of diseased liver. In fact, despite undergoing ischemia for 25 min (HVE) plus 12 during the Pringle maneuver, our patient did not show any signs of postoperative liver failure.

In situ and ex situ (bench surgery) hepatic resection is a particularly demanding surgical alternative, applicable in those cases in which the resection of the IVC is also associated with the reconstruction of the hepatic veins.[4]

In the literature, many varied surgical options are described in the reconstruction of the IVC, when this cannot be repaired primarily. Autologous veins have been used with success; however, prosthetic materials are feasible and produce a long patency. An 18–20 mm Goretx® or Dacron® graft appears superior in terms of patency of that resistance, and this prosthesis is, therefore, the one most frequently used in different surgical settings to reconstruct the cava. The most serious problems that may arise with the use of the prosthesis are infection and thrombosis.[10]

The risk of infection after liver resection is a well-documented problem, which varies between 8 and 28%, thus some authors have recommended the use of an omental wrap to protect the caval prosthesis.

Patency of the caval graft is 70% at 5 years, and systemic heparinization started postoperatively, with subsequent conversion to oral warfarin sodium, is therefore highly recommended. Alternatively, oral platelet inhibitors may be used if oral anticoagulants are contraindicated.

Little has been published on the outcome of primary and metastatic liver tumors involving the inferior vena cava, as this surgery is still considered too complex and high risk for mortality and morbidity. In the most important cohorts that appear in the literature, the mortality rate is between 9 and 30%. Despite the high risk faced by patients with this tumor, this high-risk surgery offers the only chance of curing tumors that would otherwise be considered non-resectable.[11] However, it is worth noting that 5-year overall survival varies between 22 and 30%, an outcome entirely comparable to the survival of patients undergoing hepatic resection for colon-rectal metastasis.

4. Conclusion

At present, patients with large tumors involving both liver and vena cava may be candidates for liver resection and replacement of the vena cava, achieving long-term survival in selected cases. The surgical techniques used in the resection of these tumors require specialized centers with surgeons experienced in complex processes of hepato-biliary surgery.

Key learning points

- Hepatic resection of tumors invading the IVC was considered until recently an absolute contraindication to surgery.
- Innovative and aggressive surgical techniques, such as hepatic vascular exclusion (HVE), veno-venous bypass and ex vivo hepatic resection, have been reported in dealing with hepatic tumors involving IVC.
- Patients with large tumors involving both liver and vena cava may be candidates for liver resection and replacement of the vena cava achieving long-term survival in selected cases.

Conflict of interest

All authors have no conflict of interest.

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Ethical approval

Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Author contributions

Gian Piero Guerrini Ph.D. contributed in data collection, analysis and writing the manuscript. Paolo Soliani MD was the 1st surgeon who performed the hepatic resection and contributed in writing the article.

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