

Letter to the Editor

Liver autotransplantation for an IVC tumor

Mitsuhisa Takatsuki, Susumu Eguchi, Koji Hashizume, Akihiko Soyama, Masaaki

Hidaka, Kazuyoshi Tanigawa, Kiyoyuki Eishi, Tamotsu Kuroki

Department of Surgery and Cardiovascular surgery, Nagasaki University

Graduate School of Biomedical Sciences, Nagasaki, 852-8501, Japan

Correspondence and reprints requests to: Dr. S Eguchi,

Department of Surgery, Nagasaki University Graduate School of Biomedical

Sciences, 1-7-1 Sakamoto, Nagasaki, 852-8501, Japan.

Tel: 81-95-819-7316, Fax: 81-95-819-7319, e-mail:sueguchi@nagasaki-u.ac.jp

Word count: 1249 words

Key word: liver autotransplantation, IVC tumor, extracorporeal resection

Inferior vena cava (IVC) tumors are rare, and have been reported to account for approximately 0.5 % of all sarcomas affecting adults, and represent fewer than one in 100,000 of all malignancies.¹ The only possible treatment is generally resection. There have been several reports which showed the successful removal of an IVC leiomyosarcoma with the infrahepatic IVC using artificial vessels.²⁻⁴ However, there have been a few reports of successful removal of a far advanced IVC tumor, extended beyond the orifice of the hepatic veins.^{5,6} We herein describe the first case of an IVC tumor that had extended to the right atrium, which was successfully treated with extracorporeal resection and liver autotransplantation.

A 40-year-old female presented with leg edema and was eventually diagnosed to have an IVC tumor originating at the level of infrahepatic IVC, extending to the right atrium (Fig. 1A, B). After an upper midline abdominal incision was made, the whole abdomen was found to be free of peritoneal dissemination. Subsequently, the incision was extended to a long thoraco-abdominal incision with midline sternotomy. After Kocher's duodenal mobilization, the IVC tumor was found to be resectable without the need for pancreaticoduodenectomy. However, the tumor extending to the right atrium could not be dissected from the wall of the IVC at the level of the hepatic veins.

Because three confluences of the major hepatic veins were involved, the liver and IVC, including the whole tumor, needed to be removed *en bloc* with a cardiectomy. Under extracorporeal circulation from the portal vein, the infrarenal IVC and the superior VC to the ascending aorta with an artificial cardiopulmonary device, the liver with the IVC and PV, HA and common bile duct was removed *en bloc*.

In a basin with ice-cold histidine-tryptophan-ketoglutarate (HTK) solution, the IVC, including the tumor, was resected (Fig. 1C). Subsequently, the liver was flushed via the portal vein with cold HTK solution. The hepatic veins were anastomosed to the prosthetic PTFE graft (Goretex, W. L. Gore and Associates Inc., Newark, DE, USA), which was 20 mm in diameter in an end-to-end manner (Fig. 1C) to ensure the outflow of the liver. First, the rings of the PTFE graft at the estimated anastomosis sites were removed, and the longitudinal hole for the right hepatic vein was made on the PTFE graft. The anastomosis was made with 4-0 non-absorbable Polypropylene (Prolene®) running sutures followed by making the transverse hole for the middle/left hepatic vein to allow for better adjustment of the location in the same manner.

Liver autotransplantation with prosthetic IVC was performed using the same procedure used for conventional whole-liver transplantation. Since the caudal tip of the IVC tumor was located at the level of confluence of the right renal vein (RRV), we

temporarily clamped the RRV and cut it at the confluent to IVC. Subsequently, the RRV was anastomosed to the caudal side of the remaining native IVC. Therefore, the right kidney was not removed, while the left renal vein was completely transected.

The duration of the entire operation was 859 minutes. The blood loss was 15,500 cc, including the blood that was used to flush the liver and IVC using an autologous blood recovery system. The postoperative course was uneventful in the intensive care unit, without any significant derangement in the liver function.

The pathological diagnosis indicated leiomyosarcoma of the IVC. The patient is currently doing well with good liver function and patent hepatic veins, as confirmed by contrast-enhanced computed tomography (Fig. 1D) at six months after the surgery.

There have been several reports of very aggressive hepatectomy using a back table procedure for advanced liver tumors, including those using liver transplantation techniques.^{7,8} We herein showed that such an approach can be applied not only for liver tumors, but also for advanced IVC tumors. When the tumor is located at the infrahepatic IVC, it can be removed while preserving the liver. When the tumor extends to the level of the orifice of the hepatic veins, IVC tumor removal with right or left hepatectomy can be performed.⁹ However, in the present case, the tumor extended beyond the hepatic veins up to the right atrium, so we decided to perform liver autotransplantation with

removal of the IVC tumor with the whole liver.

Liver autotransplantation has been reported after extracorporeal liver resection, however, there have been no reports of the treatment of an IVC tumor using this technique. Another option to resect the IVC tumor could be *in situ* excision with cold preservation through the portal vein with the liver in place, called hypothermic preservation.^{10,11} However it was thought that it would be difficult to reconstruct all three hepatic veins with the prosthetic IVC *in situ*, because the liver cannot be flipped back *in situ* to make a precise anastomosis, unless a hemihepatectomy is performed in cases with severely congested liver.

There have been several reports indicating that only resection may offer a chance of long-term survival for patients suffering from leiomyosarcoma of the IVC.¹² We have not considered using any adjuvant chemotherapy because of the lack of evidence of any residual tumor so far. However, very close follow-up is needed because of the malignant nature of the tumor.

In conclusion, we experienced a rare case of IVC leiomyosarcoma extending to the right atrium, for which extracorporeal resection, followed by liver autotransplantation with a PTFE graft substituted for the original IVC. Only the liver transplant technique allowed us to complete the total excision of the tumor to potentially

provide long-term survival. Therefore, close collaboration between transplant and HPB surgeons can make this type of complicated surgery possible.

REFERENCES

1. Hollenbeck ST, Grobmyer SR, Kent KC, et al. Surgical treatment and outcomes of patients with primary inferior vena cava leiomyosarcoma. *J Am Coll Surg* 2003; 197:575–9.
2. Dull BZ, Smith B, Tefera G, Weber S. Surgical management of retroperitoneal leiomyosarcoma arising from the inferior vena cava. *J Gastrointest Surg.* 2013;17:2166-71.
3. Fiore M, Colombo C, Locati P, et al. Surgical technique, morbidity, and outcome of primary inferior vena cava involving retroperitoneal sarcoma. *Ann Surg Oncol* 2012;19:511-8.
4. Liu Y, Sun Y, Jiang Y, et al. A novel strategy of vascular reconstruction after radical resection of an inferior vena cava leiomyosarcoma. *Ann Vasc Surg.* 2013;27:803.
5. Hassan M, Ciancio G, Shirodkar SP, et al. Surgical technique of removal of inferior vena cava leiomyosarcoma extending into the right atrium without deep hypothermic circulatory arrest. *J Card Surg.* 2010;25:277-1.
6. Lotze U, Reponova J, Muth G, et al. Leiomyosarcoma of the inferior vena cava extending into the right atrium. A rare differential diagnosis of a right atrial tumor with fatal outcome. *Herz.* 2012;37:573-8.

7. Wen PH, Lin KH, Chen YL, Hsieh CE, Ko CJ, Kuo SJ. Extracorporeal hepatic resection and autotransplantation using temporary portocaval shunt provides an improved solution for conventionally unresectable HCC. *Dig Dis Sci.* 2013;58:3637-40.
8. Forni E, Meriggi F. Bench surgery and liver autotransplantation. Personal experience and technical considerations. *G Chir.* 1995;16:407-13.
9. Chan AC, Chan SC, Yiu MK, Ho KL, Wong EM, LoCM. Technical considerations for radical resection of a primary leiomyosarcoma of the vena cava. 2012;14:565-8.
10. Dubay D, Gallinger S, Hawryluck L, Swallow C, McCluskey S, McGilvray I. In situ hypothermic liver preservation during radical liver resection with major vascular reconstruction. *Br J Surg.* 2009;96:1429-36.
11. Barakat O, Hoef J, Ozaki CF, Patrick Wood R. Extended right trisegmentectomy using in situ hypothermic perfusion with modified HTK solution for a large intrahepatic cholangiocarcinoma. *J Surg Oncol.* 2007;95:587-92.
12. Mann GN, Mann LV, Levine EA, Shen P. Primary leiomyosarcoma of the inferior vena cava: a 2-institution analysis of outcomes. *Surgery.* 2012;151:261-7.

Figure legends

Figure 1.

(A) Contrast-enhanced computed tomography showed an IVC tumor (arrow). (B) Schematic drawing of the tumor originating at the level of infrahepatic IVC, extending to the right atrium. (C) The IVC tumor was separated from the liver on the back table.

Figure 2.

(A) The right hepatic vein was anastomosed to the prosthetic IVC. (B) The trunk of the middle and left hepatic vein was ready to be anastomosed to the prosthetic IVC. (C) Just before implantation back to the patient. (D) Computed tomography showed the patent hepatic veins after liver autotransplantation.

Figure 1 Preoperative imaging of the IVC tumor and ex vivo resection

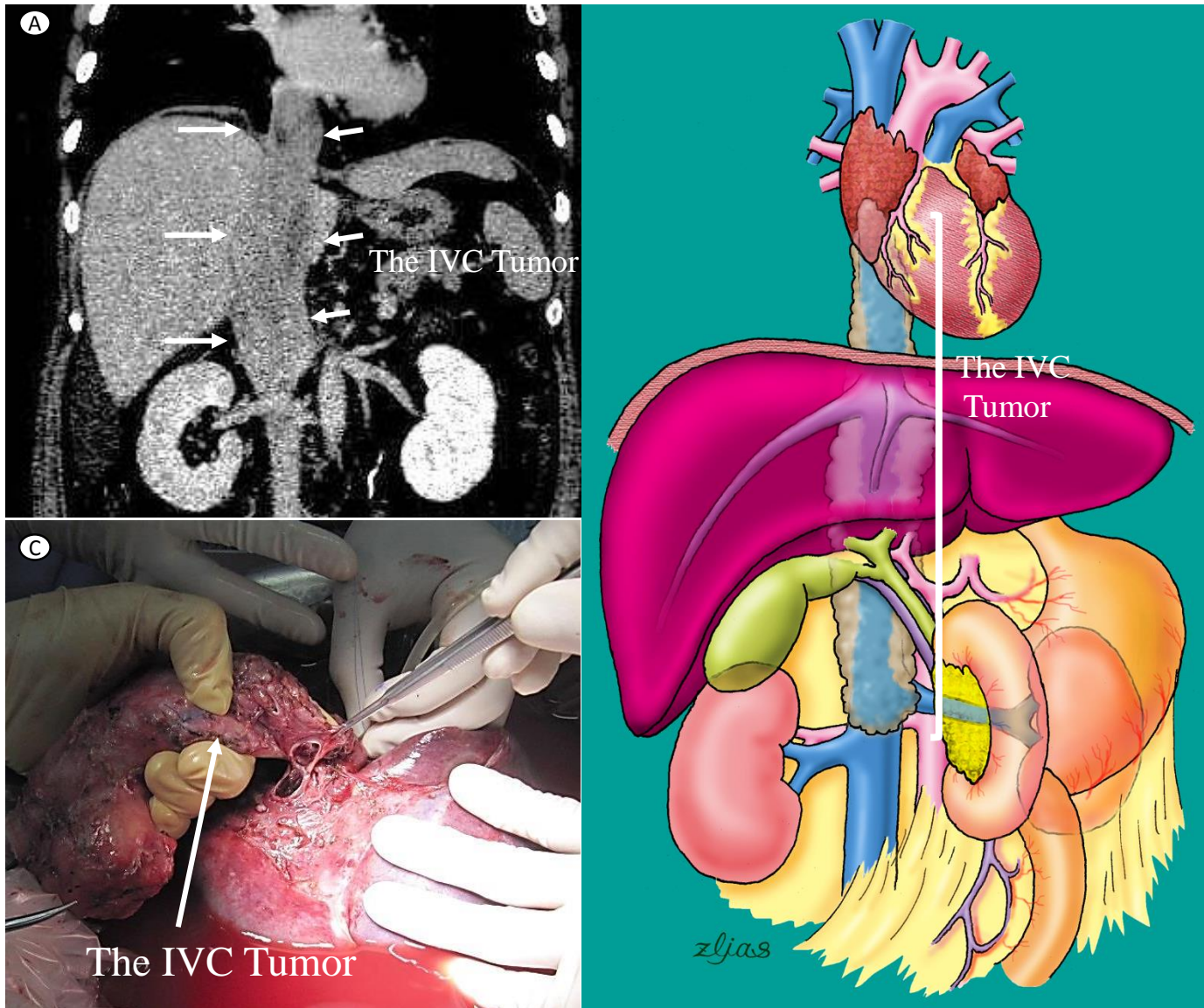


Figure 2 Reconstruction of the hepatic veins and postoperative imaging

