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35.1 History

Ex vivo liver resection and autotransplantation (ELRA) was first introduced by Pichlmayr R (Klinik für Abdominal- und Transplantationschirurgie, Medizinischen Hochschule, Hannover, FRG) [1]. The procedure was performed in February 1988 in a 46-year-old patient to remove large metastases from a leiomyosarcoma of the stomach. Subsequently, Hannoun et al. [2] and Sauvanet et al. [3] developed a simplified technique of “ex situ” hepatic surgery, in which wide access to all parts of the liver is provided by sectioning the infrahepatic and suprahepatic vena cava, while preserving the continuity of the portal triad.

The fundamentals of ELRA can be integrated with two major technical features of modern liver transplantation and hepatectomy, namely, the use of hypothermic perfusion and venous bypass, in order to overcome the limitations of ischemic damage to the liver in unresectable liver tumors. Clinical practice has demonstrated that ELRA is a safe and effective approach to radical resection for tumors that are routinely thought to be unresectable due to a posterior location in the liver or invasion of the vena cava. Vascular repairs and reconstructions are also possible, especially in cases of vena caval invasion. It is considered to be landmark innovations in liver transplantation to break through the taboo of central intrahepatic lesions invading the main hepatic vein of inferior caval vein.

35.2 Indications

ELRA can be used for the resection of tumors that lie deep within the liver and invade or compress the main hepatic vein as it enters the inferior vena cava, especially the posthepatic

inferior vena cava. This technique was initially used for hilar hepatocellular tumors, Klatskin tumors, or metastases that invade the main hepatic vein or posthepatic inferior vena cava. Recently, the use of this technique has also been reported for the treatment of benign liver lesions (such as giant hepatic hemangioma or hepatic alveolar echinococcosis) and serious liver injuries [4–6].

However, it should be noted that ELRA is a complicated and high-risk operation. Patients with benign hepatic diseases are often the best candidates for the procedure due to improved long-term results.

Contraindications: Patients with liver lesions and diffuse hepatic disease have a higher incidence of liver failure after surgery due to the complete bypass of the liver’s blood supply during ex-vivo liver resection under hypothermic perfusion.

35.3 Autotransplantation

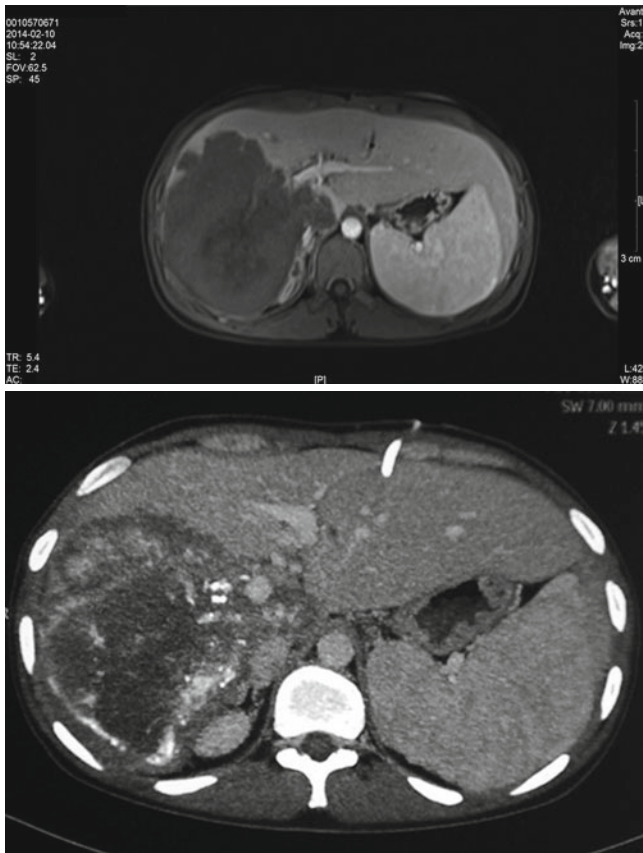
The following passage presents a case study of the use of the ELRA procedure in a female patient with hepatic alveolar echinococcosis at the author’s hospital. A 43-year-old woman was transferred to our center due to a 3-year history of liver lesions. Laboratory examinations demonstrated a total bilirubin level of 269.5 $\mu\text{mol/L}$. After treatment with persistent percutaneous transhepatic cholangial drainage (PTCD) and supportive care, the patient’s liver function recovered to a normal level (with a Child-Pugh score of 5), and she was prepared for surgery (Figs. 35.1, 35.2, 35.3 and 35.4).

35.3.1 Resection of the Liver

35.3.1.1 Body Position and Choice of Incision

The patient should be placed in the supine position, and the great saphenous veins should be disinfected for stripping, when necessary. The Mercedes incision was chosen for

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Figs. 35.1 and 35.2 Preoperative axial CT image of the proximal porta hepatis

abdominal exploration which range from right linea axillaris media and lateral margin of left rectus abdominis exoloma.

35.3.1.2 Abdominal Exploration

The various organs of the pelvic and abdominal cavities should be explored in the appropriate order to characterize the extrahepatic and perihepatic extent of disease.

35.3.1.3 Anatomy of the First Porta

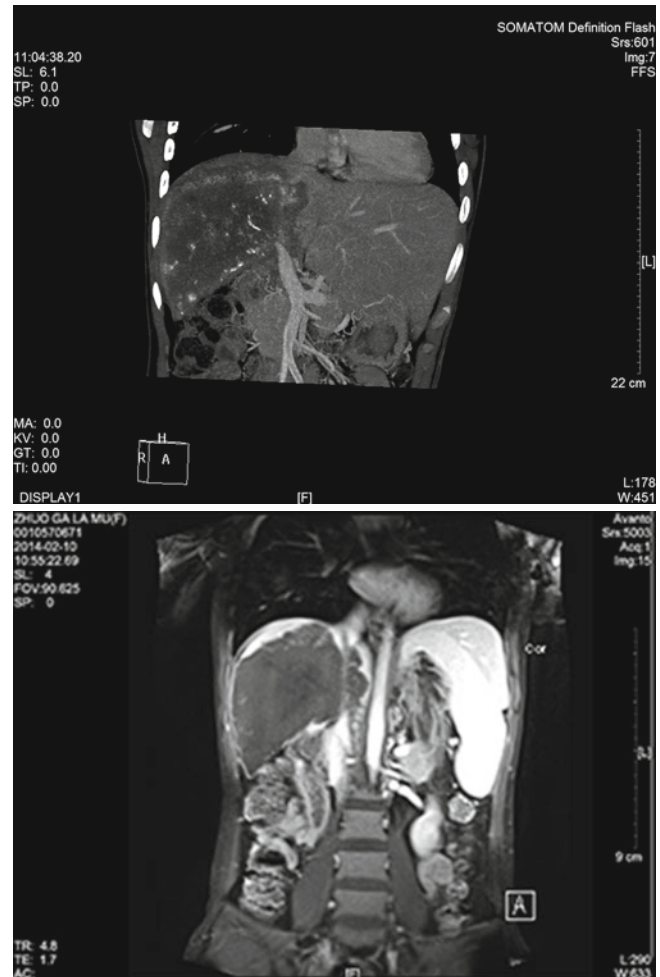
Efforts should be made to avoid damaging the bile ducts, hepatic arteries, and portal veins, since the resected liver will ultimately be transplanted back in situ with anastomosis of the first porta (Fig. 35.5).

35.3.1.4 Lysis of the Perihepatic Ligaments

The perihepatic ligaments are usually invaded, especially the diaphragmatic muscle. Sometimes, part of the diaphragmatic muscle should also be resected (Figs. 35.6 and 35.7).

35.3.1.5 Resection of the Liver

After mobilizing the perihepatic structures, resection begins. The structures should be transected in the following order: the bile duct, hepatic arteries, and portal veins in the first



Figs. 35.3 and 35.4 Preoperative coronal CT image of the proximal porta hepatis

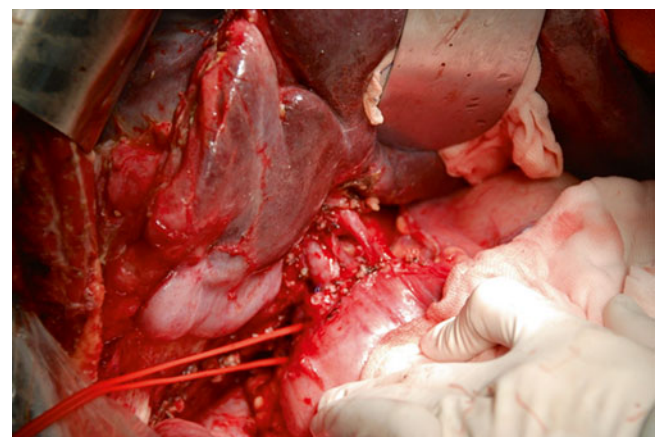


Fig. 35.5 Invasion of the first hilar structure

porta, then the posthepatic inferior vena cava, and finally, the suprahepatic vena cava and the liver.

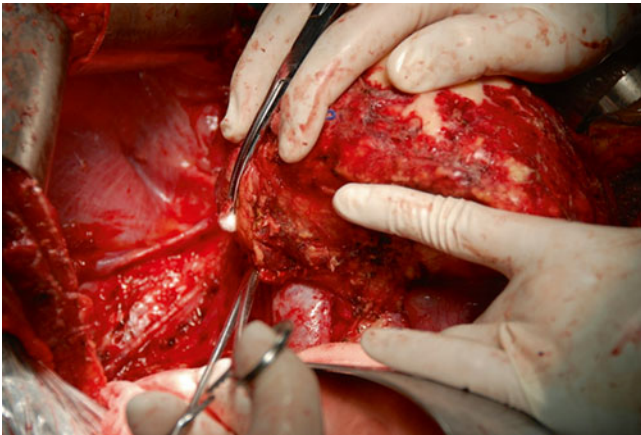


Fig. 35.6 Invasion of the diaphragmatic muscle and mobilization of the liver

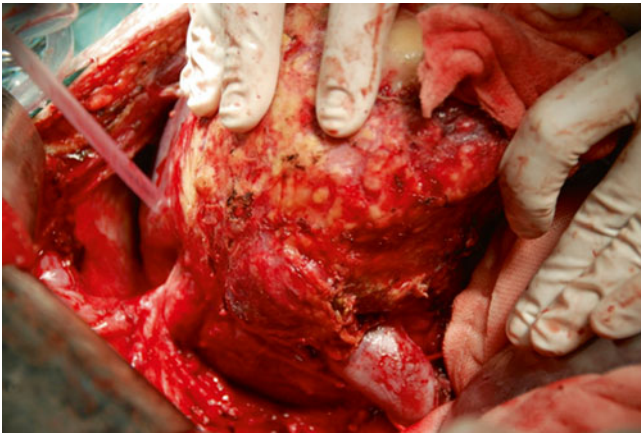


Fig. 35.7 Invasion of the posthepatic inferior vena cava

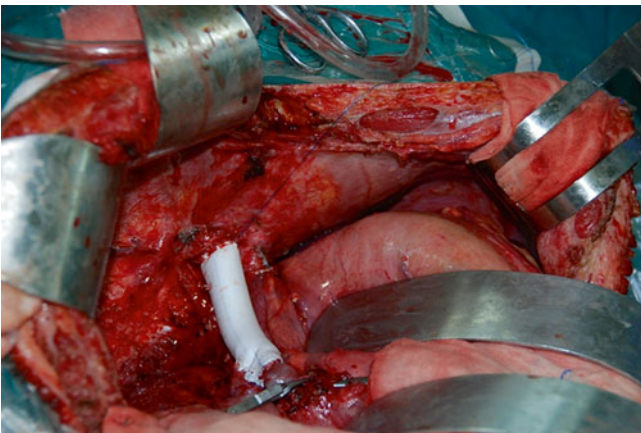


Fig. 35.8 Reconstruction of the inferior vena cava and portal vein with an artificial blood vessel

35.3.2 Reconstruction with an Artificial Blood Vessel

The resected part of the IVC was reconstructed with an artificial blood vessel. Then, an end-to-side anastomosis was created between the portal vein and the artificial blood vessel for the portacaval shunt. This can restore circulation in the portal venous system and stabilize the underlying circulation and the internal environment (Fig. 35.8).

35.3.3 Parenchymal Transection and Repair

As soon as the liver was completely resected, the liver graft was perfused with University of Wisconsin solution (0–4 °C) via the portal vein. Parenchymal transection should be based on the segmental anatomy of the liver, and the reserved hilar structures should be repaired for the reconstruction (Figs. 35.9, 35.10, 35.11, 35.12 and 35.13).

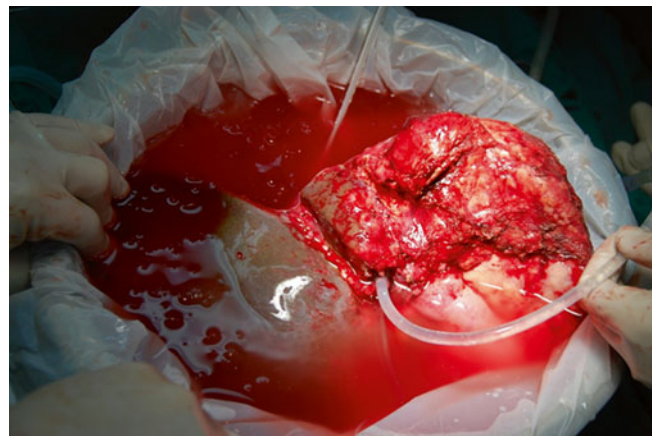


Fig. 35.9 Perfusion with University of Wisconsin solution on the back table



Fig. 35.10 Parenchymal transection on the back table

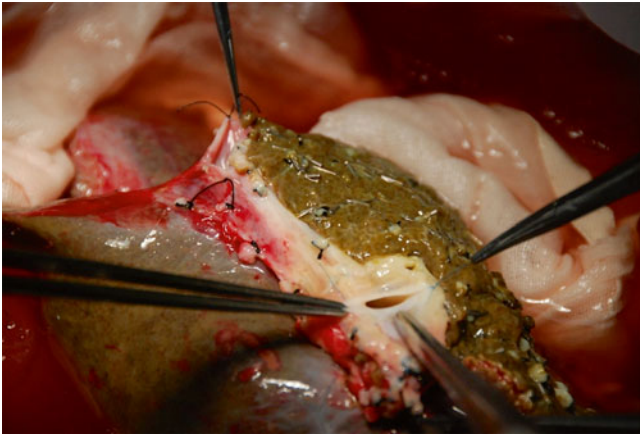


Fig. 35.11 Segments 2 and 3, which were prepared for transplant, and repair of hilar structures

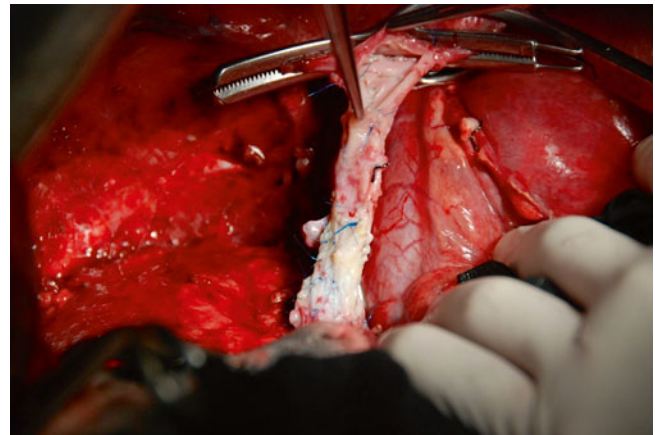


Fig. 35.14 Reconstruction of the posthepatic inferior vena cava with an autologous venous graft after removal of the temporary artificial blood vessel and before transplantation



Figs. 35.12 and 35.13 Segments 1, 4, 5, 6, 7, and 8, which were resected

35.3.4 Transplantation of the New Liver

Reconstructions were performed using a standard method that was described previously for living-donor liver transplantation: First, the hepatic vein was reconstructed,

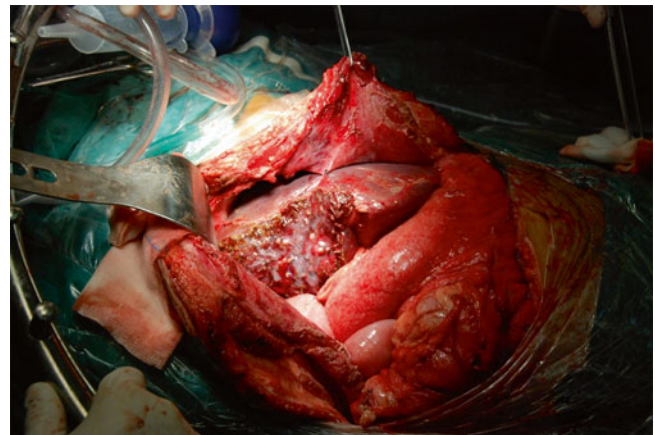


Fig. 35.15 The operative field after autotransplantation

followed by the portal vein, the hepatic artery, and the bile duct. The hepatic biliary duct was drained by a Roux-en-Y hepaticojejunostomy, as it is often being invaded by the primary disease (Figs. 35.14 and 35.15).

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