Extended hepatic resection with transplantation back-up for an “unresectable” tumour

Abstract Liver transplantation (LT) for malignancy has had disappointing long-term results due to tumour recurrence. Ex-vivo dissection and auto-transplantation have had poor results when the tumor was obstructing bile ducts. Advances in liver surgery have made extensive liver resection safer, but cases of “unresectable” tumours due to site and size still present. A 10-year-old boy was referred with jaundice due to a 6 × 8-cm central (segment 4) tumour shown on biopsy to be a fibrolamellar hepatocellular carcinoma. Ultrasound (US) and Computed Tomography also showed dilatation of intrahepatic bile ducts in both lobes. Angiography showed a large tumour mass supplied by the left branch of the hepatic artery, a low take-off of a right branch of the hepatic artery, and a very displaced but patent portal vein. The initial surgical consensus was that the tumour was unresectable. The patient was listed for LT with the plan of first attempting resection with a liver graft-in-waiting. An extended left hepatectomy was performed under total vascular exclusion with resection of the tumour, which had extended from segment 4 into surrounding segments 1, 3, 5, and 8. Intraoperative US assisted in planning the resection. The right hepatic vein, artery, and the right branch of the portal vein could be preserved and a Roux loop was anastomosed to a markedly dilated segment 6 and 7 intrahepatic duct for bile drainage. Vascular exclusion time was 30 min. The patient made a good recovery without major complications. Jaundice and bile-duct dilatation resolved. On follow up at 5 years there was no recurrence. The liver graft-in-waiting gave the surgical team confidence to proceed with an extensive resection beyond a “point of no return” and allowed good clearance of the disease and avoidance of LT with all the long-term consequences of immunosuppression. This mandates that extensive hepatic surgery in children should be carried out in centres that have a facility for LT should the need arise.

Keywords Hepatocellular carcinoma · Children · Resection · Transplantation

Introduction

Liver transplantation (LT) for malignancy has had disappointing long-term results due to local tumour recurrence and metastases and is now usually only recommended for stage II hepatocellular carcinomas (HCC), very extensive hepatoblastomas, and less aggressive tumours such as haemangioendotheliomas [18, 19]. A single-centre experience where expertise in resectional surgery and LT was available has been more optimistic [18]; Pichlmayr suggested auto-transplantation with ex-vivo dissection but had disappointing results when the tumour was obstructing bile flow [20].

Recent advances in liver surgery using techniques of in-flow occlusion, total vascular exclusion, or even in-situ flush with preservation solutions have made extensive liver resection possible, thus avoiding LT [3, 5, 7, 8, 11–13, 19, 20]. We report such a case where full assessment of resectability could only be done by mobilisation and dissection of the liver beyond a “point of no return”. With a donor liver available for transplantation should unresectability have been confirmed,
successful extensive resection was undertaken with confidence and safety.

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**Case report**

A 10-year-old boy was referred from an outlying centre. He had presented 1 month previously with pruritus, jaundice, weight loss, and hepatomegaly. Investigations confirmed cholestatic jaundice and a 6-cm-diameter, centrally-placed mass in the liver. At laparotomy, a large mass was found in the liver, predominantly in segment 4. Biopsy confirmed a HCC, fibrolamellar type, and adjacent lymph nodes in the porta hepatis were negative for tumour. Hepatitis antigens were negative and serum alpha-fetoprotein was not elevated.

Examination revealed a well-grown jaundiced boy with evidence of recent weight loss (body wt. 28 kg). There was no palpable lymphadenopathy, anaemia, clubbing, or oedema. The cardiovascular and respiratory systems were normal. Abdominal examination revealed the scar of his recent laparotomy with firm, non-tender hepatomegaly palpable to 8 cm below the costal margin. The spleen was enlarged at 1 cm below the left costal margin. A complete blood count and clotting profile were within normal limits, as were serum urea, creatinine, and electrolytes. Liver function tests (LFT) showed a total bilirubin level of 169 μmol/l, conjugated bilirubin 124 μmol/l, alkaline phosphatase 181 IU/l (n = 75–250), alanine transaminase 45 IU/l (n = <30), and gamma glutaryl transferase 103 IU/l (n = 5–28). A chest radiograph was normal. Ultrasound examination (US) of the abdomen showed a 6 × 6.5 × 6.8-cm mass involving the posterior aspect of Couinaud segment 4 (Fig. 1). The biliary tree was markedly dilated on both the right and left sides, more so on the left. The portal vein (PV) was patent with good flow. Computed tomography (CT) with contrast (Ultravist 3 ml/kg) confirmed the tumour mass displacing the right branch of the PV posteriorly but no flow in the left branch. Angiography showed tumour vasculature supplied by the left branch of the hepatic artery (Fig. 2). A proximal take-off right hepatic artery (RHA) was displaced but not encased by tumour.

The surgical consensus was that due to its size and situation, the tumour was unlikely to be resectable. Adriamycin in a reduced dose due to the cholestasis (30 mg/m²) and cisplatinum (80 mg/m²) was given in an attempt to shrink the tumour, but without response [4]. A decision was made to explore and attempt resection with a donor liver available for LT should the tumour be unresectable. During a 6-week-long wait for a suitable donor liver the tumour gradually increased in size. Provisional arrangements were made for a second recipient to be available should the donor organ not be used.

At laparotomy the whole liver was grossly enlarged, bile-stained, and of firm consistency. A 6 × 8-cm tumour arising in segment 4 but extending into segments 1, 3, 5, and 8 was identified. Intra-operative US indicated that the right hepatic vein and segments 6 and 7 were free of tumour [7]. A low-dividing RHA and right branch of the PV were displaced and embraced but not involved by tumour. The left branch of the PV and left hepatic artery (LHA) entered the tumour mass directly. The liver was fully mobilised. After cholecystectomy and division of the common bile duct, the PV and hepatic artery could be adequately visualised. The LHA and left branch of the PV were also divided and ligated. The RHA and PV with the right branch intact were carefully dissected free of the tumour and preserved.

Using the technique of total vascular occlusion, an extended left hepatectomy was performed with resection of segments 5, 8, 4, 3, 2, and most of 1 [3]. Haemostasis was obtained by suture ligation and fibrin tissue glue.

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**Fig. 1** Axial post-contrast CT scan of abdomen shows expansion of segments 4A and 4B (Couinaud) of liver with inhomogeneous enhancement. Portal vein is displaced posteriorly, compressed, and draped around mass. Biliary ducts are markedly dilated. Segments 2 and 3 appear reduced in size with more severe duct dilatation

**Fig. 2** The capillary phase of selective left hepatic angiogram shows vessels displaced around circumference of mass as well as significant capillary blush. Tumour derives most of blood supply from left hepatic artery.