Central Hepatic Resection for Pediatric Tumors

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Background/Purpose: Resection of hepatic malignancies in childhood has been facilitated greatly by an understanding of hepatic segmental anatomy. This report documents the indications and technique of central hepatic resection (mesohepatectomy) in children with hepatic malignancies.

Methods: This is a retrospective study, and data are obtained from patient charts and operative reports. Three patients underwent central hepatic resection on or between June 27, 1997 and October 1, 1999.

Results: All patients were boys, and their ages at diagnosis were 0.3, 0.8, and 3.8 years. Two had hepatoblastoma and one central hepatic metastases from a poorly defined epithelial malignancy. All 3 received neoadjuvant chemotherapy before hepatic resection. Segments IV, V, and VIII were removed in 2, and IV and V in the third. All patients survived, and histopathologic margins were clear in each. One patient had a postoperative bile collection treated with percutaneous catheter drainage. At follow-up, all patients remain alive without evidence of disease, and all have normal hepatic function.

Conclusion: Central hepatic resection of malignant tumors involving segments IV, V, and VIII is feasible and effective in childhood.

INDEX WORDS: Liver tumor, central hepatic resection, mesohepatectomy, segmental liver resection.

THE SEGMENTAL BLOOD supply and biliary drainage of the liver was elucidated by Couinaud with a series of articles beginning in 1957.[1,2] Surgeons were able to exploit this greater understanding of hepatic segmental anatomy by devising anatomic resections of the right and left lobes through bloodless planes. A logical progression to extended hepatic resections rapidly followed and now is routinely applied to liver tumors occurring in childhood.[3-5] Treatment of hepatic metastases from colorectal carcinoma or local invasion by cholangiocarcinoma stimulated a further refinement in anatomic liver resection applying the technique to removal of individual segments or clusters of segments.[6-11]

Hepatic lesions that are located centrally and involve all or part of segments IV, V, and VII are amenable to a segment-based central hepatic resection. This helps avoid the use of extended hepatectomy and preserves normal hepatic substance. Because of the rarity of central hepatic resection (mesohepatectomy) in adults and the lack of reports in children, we report our experience with 3 consecutive cases in childhood.

MATERIALS AND METHODS

The 3 cases were performed consecutively on June 27, 1997; January 15, 1999; and October 1, 1999. Data were obtained from the patient charts, operative reports, and clinic follow-up notes.

Preoperative Evaluation

Preoperative investigation included liver and renal function tests, complete blood count, and coagulation profile. Magnetic resonance imaging (MRI) and magnetic resonance cholangiography was done in all patients, and arteriography was not done. Patients were selected for central resection when the lesion or lesions were confined to segments IV, V, and VIII and there was no invasion into the portal vein. The masses were relatively small (2.2 to 2.9 cm in greatest diameter) so that an adequate margin of normal hepatic tissue could be obtained with this segmental approach. Nonanatomic resection was not feasible because of the proximity of the middle hepatic and anterior sectoral branch of the portal vein.

Operative Technique

Exposure is via bilateral subcostal incisions extended superiorly in the midline to the xiphoid. The liver then is mobilized, and a self-retaining retractor is used to retract the costal margins superiorly, anteriorly, and laterally. The hepatoduodenal ligament is surrounded with a vascular tape in preparation for a Pringle maneuver.

The hilar plate is lowered, and the confluence of the right and left hepatic arteries and the portal veins is exposed as previously described and illustrated.[5] The recurrent branches of the left portal vein to segment IV are divided in the umbilical fissure. Branches to the left lateral segment (left main portal pedicle) and caudate lobe are preserved. The middle hepatic vein is ligated as dissection approaches the vena cava.

Next, control of the arterial and portal inflow to segments V and VIII is accomplished by ligation of the right anterior sectoral pedicle as

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Presented at the 53rd Annual Meeting of the Section on Surgery of the American Academy of Pediatrics, San Francisco, California, October 19-21, 2001.

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0022-3468/02/3707-0009$35.00/0
doi:10.1053/jpsu.2002.33825

Fig 2. Operative photograph of patient 2 after middle hepatic resection. The remaining segments are denoted. A considerable amount of hepatic parenchyma can be preserved using this procedure in patients with central but relatively small tumors.

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Fig 1. The divisions of the portal and hepatic veins. The anterior sectoral branch and the recurrent branches to segment IV are illustrated. The middle hepatic vein is shown superiorly and is isolated and divided, usually as the last step, in middle hepatic resection. (Image courtesy of Vesalius.com. Reprinted with permission.)

described previously.[5] The anatomic location of these vessels is illustrated in Fig 1. Partial division of the hepatic parenchyma sometimes is required to identify anterior and posterior sectoral pedicles. The fissure of Gans is a reliable indicator of the course of the posterior pedicle and is used for orientation. Once the anterior sectoral pedicle is identified, it is surrounded with a vascular tape and clamped with a vascular bulldog clamp. This will result in a clear demarcation of segments V and VIII anterior to the right hepatic vein. This will be the plane of resection during parenchymal transection. Once the anterior sectoral pedicle is clearly defined, it is securely ligated. At this point segments IV, V, and VIII are almost completely isolated from the rest of the liver. A Pringle maneuver is carried out, and the remaining bridge of hepatic substance posteriorly and inferiorly is divided using crushing technique with clip ligation of vascular and biliary radicals. Drains are not used. Figure 2 shows the operative field after removal of segments IV, V, and VIII.

RESULTS

Three boys underwent central hepatic resection during this period with ages at diagnosis of 0.3, 0.8, and 3.8 years, respectively (Table 1). Central hepatic resection was performed 75, 171, and 182 days after diagnosis in these patients. Patient demographics, blood loss and transfusion, and hospital and intensive care unit stay is summarized in Table 1.

Two patients underwent resection of centrally located hepatoblastomas (Table 2). Interestingly, both patients with hepatoblastoma had the Beckwith-Wiedemann syndrome. Both hepatoblastoma patients had undergone neoadjuvant chemotherapy with a good response. Both patients had microscopically clear margins of resection, and alpha-fetoprotein levels fell to the normal range postoperatively. They remain without evidence of disease.

The third patient had multiple metastases confined to the central segments from a poorly classified epithelial tumor. This tumor had arisen in the gastric antrum, and he had undergone a previous distal gastrectomy at an outside institution. At presentation to Memorial Sloan Kettering (MSKCC) the hepatic metastases were rebiopsied. Electron microscopy indicated an epithelial origin of this tumor, but the diagnosis could not be further refined. A metastatic workup was otherwise negative. Adjuvant chemotherapy had no effect on the liver tumors, and a central hepatic resection was performed.

Table 1. Diagnosis, Demographics, and Operative Data

Patient No.	Age at Diagnosis (yr)	Sex	Diagnosis	Age at Surgery (yr)	Weight (kg)	ICU Stay (d)	Hospital Stay (d)	Blood Loss (mL/kg)	PRBCs Transfused (mL/kg)
1	0.3	Male	Hepatoblastoma	0.6	9	4	7	11	15
2	0.8	Male	Hepatoblastoma, distal ileal lymphangioma	1.3	10	27*	30	20	25
3	3.8	Male	Epithelial neoplasm (metastatic)	4.3	14	2	6	18	None

NOTE. Both hepatoblastoma patients had Beckwith-Wiedemann syndrome, and patient number 2 had significant tongue enlargement. Resultant airway obstruction delayed endotracheal extubation for 17 days. This patient also had a right upper quadrant collection of bile treated successfully by percutaneous drainage.

*Enlarged tongue in this Beckwith-Wiedemann syndrome patient delayed extubation.

Table 2. Stage, Resection Margin, and Follow-Up

Patient No.	Stage	Size (cm)	Segments Removed	Margin	Bilirubin Level (mg/L)	AST (U/L)	Albumin (g/dL)	PT (s)	Follow-Up (yr)	Status
1	T2N0M0	2.7 × 1.9	IV, V, VIII	Neg.	0.4	30	4.8	12.7	2.9	Ned
2	T2N0M0	2.2×1.0	IV, V, VIII	Neg.	0.7	25	4.7	12.2	2.4	Ned
3	metastatic	2.2×1.9 and 1.2×1.2	IV, V	Neg.	0.5	36	4.8	12.0	4.0	Ned

NOTE. Metachronous Wilms' tumors have developed in patient 1, and he has undergone 2 partial nephrectomies. He remains on adjuvant chemotherapy for the Wilms' tumors but is in remission with regard to the hepatoblastoma. Magnetic resonance images remain negative, and his alpha-fetoprotein level is normal. The bilirubin, AST albumin, and prothrombin time were the most recent postoperative determinations.

Abbreviations: Ned, no evidence of disease; PT, prothrombin time; AST, aspartate aminotransferase.

Clear microscopic margins were obtained, and the patient remains without evidence of disease (Table 2).

One patient had 2 significant postoperative complications: a bile collection and prolonged endotracheal intubation. The bile collection was associated with fever, but the patient had no other evidence of sepsis, and cultures remained negative. The collection quickly resolved with percutaneous drainage, and the drain was removed 6 weeks after surgery. The other problem that occurred was the development of postoperative upper airway obstruction caused by significant muscular hypertrophy of the tongue worsened by postoperative edema. This resolved gradually and the patient eventually made a full recovery.

DISCUSSION

Removal of individual hepatic segments or combinations of segments is now feasible because of improved understanding of intrahepatic anatomy and advances in hepatic imaging technology.[12] Central hepatic resection, sometimes called mesohepatectomy, involves removal of hepatic tissue supplied by the right and left portal pedicles. It is not a sectoral but rather a segment-oriented procedure and may be combined with removal of other segments if demanded by the clinical situation. Historically, it developed from the need to obtain surgical clearance of hilar cholangiocarcinomas or to treat biliary strictures at the hepatic bifurcation. Hart and White[13] reported on 10 adults who underwent central hepatic resection for hilar carcinomas or strictures with hepaticojejunostomy reconstruction of the biliary tract. Two patients died, and 7 of the 8 survivors had satisfactory outcomes. The procedure has been extended to include not only segments IV, V, and VIII but also segment I[14] and segment VII.[15] The technique also has been applied to centrally arising hepatocellular carcinomas.[16,17] and to carcinoma of the gallbladder.[14] This procedure also has been combined with hepatic arterial reconstruction with successful outcome.[18] These and other reports documents the feasibility and efficacy of this procedure in the treatment of various malignant tumors of the liver and biliary tract in adults.[10,19]

The major advantage of central hepatic resection is preservation of normal hepatic parenchyma. In the 3 cases in this series, the need for an extended right or left hepatic lobectomy to deal with the segment IV involvement was avoided. Scudamore et al[20] compared clinical parameters in patients undergoing hepatic lobectomy or extended lobectomy to those treated by central hepatic resection (mesohepatectomy). He found that the operative and inflow occlusion times were comparable but that the amount of resected hepatic volume and the late complication rate were significantly lower in the central resection group. In central hepatic resection the bile ducts are ligated within the hepatic pedicles. This avoids extrahepatic resection of the hepatic ducts with possible late ischemic stricture. None of the patients in the current series have developed late complications like bile duct strictures, and liver regeneration has proceeded normally.

Central hepatic resection is a rare procedure that emphasizes segmental liver anatomy. For suitable lesions it preserves hepatic parenchyma and may lower the risk of late complications like biliary tract strictures.

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