Laparoscopic Radiofrequency-Assisted Liver Resection (LRR): A Report of Two Cases

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Technological advances of the past decade have allowed an increased use of minimally invasive surgical procedures for solid organs, including the liver (2, 3, 5, 6). Currently, despite reports of laparoscopic anatomic hepatectomies in select centers for limited indications (16), laparoscopic and laparoscopic-assisted techniques have been primarily employed for nonmalignant tumors with wedge resections or left lateral segmentectomies (9, 14). Recent data have suggested that laparoscopic resection is safe for patients with small malignant tumors as well, although patients with hepatocellular carcinoma (HCC) or cirrhosis might suffer more complications (10). The use of radiofrequency energy to coagulate lines of hepatic resection has recently been shown to be useful in segmental resections in cirrhotic livers (18, 20). We have employed this technology in a novel fashion to perform laparoscopic-assisted resection of an HCC in two patients with cirrhosis.

CASE REPORTS

The first patient was a 53-year-old man with a known history of chronic hepatitis B and Childs A cirrhosis who presented with slightly elevated serum α-fetoprotein (AFP) levels and a new liver mass. He had a long history of elevated transaminases and radiographic signs of cirrhosis, without evidence of ascites, encephalopathy, or varices. His medical history was significant for a cadaveric renal transplant in 1973, for which he received mycophenolate and prednisone, and lymph node-positive melanoma. Nonlesional tissue showed established cirrhosis. His medical history was significant for alcohol abuse, diabetes, and chronic pancreatitis complicated by strictures of the biliary and pancreatic ducts. During an endoscopic ultrasound, a 4-cm lesion of the left lateral liver was incidentally noted. Imaging with MRI showed a T1-hypointense lesion in segment 2, measuring approximately 4.4 × 4.2 cm in size. Irregularities of the liver suggested cirrhosis. There was no evidence of hyperbilirubinemia, ascites, or encephalopathy. A CT-guided biopsy of the lesion was nondiagnostic.

For both patients, resection was accomplished using a laparoscopic-assisted technique, utilizing the InLine radiofrequency coagulation (ILRFC) device (Resect Medical, Fremont, CA). A 7-m right subcostal hand port was placed, as well as an infraumbilical 12-mm port and a left upper quadrant 10-mm port. A nonanatomic resection plane was identified around the mass to achieve a margin >1 cm. The hand port was used for proper localization and deployment of electrodes in the ILRFC device (Figure 2). Probes were placed full-thickness through the left lateral segment along the intended resection line. Intraoperative ultrasound was available but not necessary given the location of the mass away from the hilum. Using a standard RFA generator (Rita, Sunnyvale, CA), radiofrequency energy was applied in accordance with the instructions provided by the manufacturer. These instructions include the delivery of energy for a period of 3 min and in an amount proportional to the volume (depth) of tissue to be coagulated. This technique results in a coagulated plane of tissue approximately 1 cm wide × 5 cm long × 1–6 cm deep, depending on the depth of the electrode deployment. This procedure was repeated twice to fully coagulate the entire length of the intended resection margin. Following the tissue coagulation, parenchymal division was accomplished with blunt dissection and cautery for the first patient and with the harmonic scalpel for the second patient. No transfusions were required. The resected specimen from the first patient is shown in Figure 3.

Both patients tolerated a regular diet 24 hr postoperatively. Histopathologic examination of the specimen from the first patient revealed HCC, 3.6 cm in maximal diameter, with associated satellite nodules. Microscopically tumor margins were negative for tumor, although tumor extended to approximately 0.1 cm from the cut margin. The second patient’s pathology revealed HCC, 4.7 cm in largest dimension, with tumor 1.8 cm from the
Fig 1. Abdominal MRI, Patient 1. Note the nodular contour consistent with the patient’s known cirrhosis. A multilobular lesion in the left lateral liver (segments 2/3), hypointense on T1-weighted images, measures 3.8 × 3.4. Early arterial enhancement was identified, with central necrosis. Biopsy was consistent with hepatocellular carcinoma.

coagulated margin. In both patients, cirrhosis was noted in the nonlesional liver tissue.

**DISCUSSION**

The application of minimally invasive techniques to liver resection has been hampered by both technical hurdles and, in the case of liver malignancy, fears of oncologic inadequacy (2). Liver mobilization, vascular control, and hemostatic parenchymal transection all represent formidable challenges for the laparoscopic surgeon. Small series of laparoscopic liver resection were first presented for benign lesions (2, 3, 5, 6, 16) and recently for malignant tumors (10). With the development of new devices and refinements of existing technology, hepatic parenchymal transection has been achieved with staplers, cautery, harmonic shears, and the ultrasonic dissector to minimize bleeding (5). Others have reported success with hand-assisted laparoscopic liver resection, which facilitates liver palpation, mobilization, and compressive hemostasis (8). These many advances have enabled laparoscopic surgery to be applied to an increasingly complex variety of liver resection, to the point where laparoscopic right hepatectomy is performed at certain centers of excellence (16). Still, hemostatic parenchymal transection remains a barrier to routine laparoscopic liver resection, and laparoscopic techniques have been limited to small peripheral lesions at most centers.

The published experience of laparoscopic resection for malignancy is limited. Small series in the 1990s describe laparoscopic resection for HCC (12, 15). A recent small series demonstrates that laparoscopic resection of liver cancers is feasible and safe (10), although data do not exist on long-term disease-free survival after laparoscopic versus open resection. The feasibility of resection is limited for many patients with HCC, which often arises in the setting of chronic liver disease, cirrhosis, and limited hepatic reserve. Laparoscopic liver resection has been suggested to be feasible in cirrhotic patients who might not otherwise tolerate hepatectomy (1).

Radiofrequency ablation (RFA) is commonly used to destroy unresectable liver tumors or for surface fulguration of liver margins (17, 19). This technology has recently been employed in conventional open liver surgery to