Laparoscopic-assisted liver resection

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Abstract
Background/Purpose. The recent rapid development of innovative laparoscopic instruments and improvements in surgical skill have made laparoscopic-assisted liver resection possible. Obviously, extensive experience in laparoscopic and hepatobiliary surgery is mandatory in carrying out liver resection through the minimal access approach. Here, we describe and evaluate our results during the period 1998–2001.

Methods. During this period we attempted laparoscopic-assisted liver resection in 11 patients. There were 8 female and 3 male patients, of mean age 57.2 years (range, 28–68 years).

Results. In all but 1 patient, the laparoscopic operation was successfully performed. Indications included recurrent pyogenic cholangitis (RPC; n = 6), hepatocellular carcinoma (n = 3), colorectal liver secondary (n = 1), and hemangioma (n = 1). The mean ± SD operating time was 190 ± 62.4 min (range, 60–290 min), and mean ± SD blood loss was 394 ± 241 cc (range, 200–1000 cc). All patients but 1 were discharged within 2 weeks after the operation, and in this 1 patient, the prolonged hospital stay was due to postoperative bile leak, which was managed by combined percutaneous and endoscopic biliary drainage. With a mean follow-up of 10 months, there was no significant long-term complication.

Conclusion. In summary, laparoscopic-assisted liver resection is a feasible and safe treatment option for various liver pathologies, such as RPC and primary and secondary liver tumors.

Introduction

Laparoscopic liver resection presents a unique technical challenge and anatomical difficulty in achieving satisfactory hemostasis along the transection plane. However, as a result of skill maturation and the availability of specially designed advanced laparoscopic instruments in the past decade, complicated liver resection can now be feasibly performed. Several series of laparoscopic-assisted liver resection for primary and secondary cancers have been reported in both cirrhotic and noncirrhotic livers.

In 1993, Katkhouda et al. first performed laser resection of a hydatid cyst via a laparoscopic approach. Following this, Kaneko et al. reported the use of a microwave tissue coagulator and an abdominal wall-lift method to carry out laparoscopic liver resection in 11 patients with both primary and secondary liver tumors. Two years later, in the series of 38 cases reported by Huscher et al. it was again demonstrated that the laparoscopic approach was both feasible and safe, comparable to conventional surgery, in dealing with different liver pathologies, including benign and malignant conditions. The largest series (43 patients) of laparoscopic liver surgery was reported by Katkhouda et al. in 1999. They emphasized the importance of appropriate patient selection and the standardized “four-handed technique” in the laparoscopic management of benign solid and cystic liver pathologies.

Laparoscopic liver resection can be either a total laparoscopic resection or a hand-assisted resection. In the total laparoscopic resection, the difficulties encountered are: (1) possible massive bleeding and air embolism, (2) loss of tactile palpation, and (3) difficulty in extracting a malignant specimen; therefore, the procedure has gradually been modified to hand-assisted laparoscopic surgery (HALS) so as to overcome some of the above problems. The advantage of HALS over the total laparoscopic approach is that there is better exposure of the anatomy, and blunt dissection is possible with the assistance of the surgeon’s left hand (for a right-handed surgeon). In addition, the “laparoscopic hand” can also provide immediate hemostasis and prevent air embolism, even if branches of the hepatic vein are severed.

In this article, we describe the techniques of various approaches of laparoscopic liver resection and evaluate
the perioperative data and results of our own series of 11 patients during the period 1998–2001.

**Patient selection**

Similar to other types of laparoscopic surgery, the selection of appropriate candidates is the key to success. Absence of coagulopathy and satisfactory liver reserve, as well as a clear idea of the location and extent of the pathology, are important prerequisites.

In addition, it is also important to rule out carcinomatosis in patients with malignancies, by both preoperative imaging, including percutaneous ultrasound (US), computed tomography (CT), and hepatic arteriogram (HAG), and laparoscopic assessment. However, a history of previous abdominal surgery would not be considered as an absolute contraindication for laparoscopic assisted liver resection.

Generally, pathology located in anterior segments (Couinaud segments 2, 3, 4b, 5, 6) and on the surface of the liver would be more suitable for laparoscopic resection. These segments are also named “laparoscopic segments”, because they are more accessible by laparoscopy. In contrast, central lesions and lesions situated in the superior and postero-inferior segments (4a, 7, 8) are normally excluded. Moreover, large tumors and tumors close to major vasculature or the hilum of liver would not be suitable for laparoscopic resection.

**Instruments**

Apart from the standard instruments, the use of a laparoscopic ultrasound linear array probe, an ultrasonic surgical aspirator, a Harmonic Scalpel, and a handport are indispensable in laparoscopic assisted liver resection.

The 7.5-MHz laparoscopic ultrasound linear array probe (UST-5536-7.5MHz; Aloka, Tokyo, Japan) can accurately locate the pathology and reveal the relationship of it to the adjacent vascular structures. It also helps to rule out intrahepatic metastasis and mark the resection line for parenchymal transection. The sensitivity is guaranteed by its high frequency and absence of “abdominal wall effect”, and its deflectable tip also allows it to be adjusted according to liver contours.

The laparoscopic ultrasonic surgical aspirator (Sonopet UST2000; M&M, Tokyo, Japan) can effectively break down the liver parenchyma, with preservation of vessels and bile ducts. The use of this instrument can facilitate the identification of all these structures for subsequent clipping and division. Its use is similar to the use of such an aspirator in open surgery, but of course with a long laparoscopic handpiece.

The Harmonic Scalpel (Ultracision; Ethicon, Cincinnati, OH, USA) has proven to be a useful instrument in advanced laparoscopic surgery, and liver resection is no exception, as the device can effectively seal off small vessels and bile duct with minimal fogging. Moreover, it seldom sticks to liver parenchyma, as does a conventional electrocautery device.

The introduction of a handport (Handport System, Smith and Nephew, York, UK) is to make up for the inadequacy of a total laparoscopic resection. The length of the incision is made according to the surgeon’s palm size, and glove size is a close indicator of the required incision length, e.g., a 7-cm incision for a surgeon with a glove size of 7. The incision is made at the right side of the abdomen to allow the placement of the surgeon’s nondominant hand, and it is important to ascertain that there is no trocar placement within the diameter of the handport retractor. The wound is protected by the inflatable retractor, and the surgeon’s hand can then be inserted with the plastic sleeve tightly covering the retractor. An air leak is rather unusual, and the cuff can also protect the wound against tumor implantation. Instruments such as a gauze roll and artery clamp can be inserted via the handport if required.

**Technique**

**Laparoscopy and laparoscopic ultrasound**

Irrespective of extensive preoperative imagings, small peritoneal and intrahepatic metastases still cannot be completely excluded, the presence of which contradicts any major resection. Therefore, routine laparoscopic staging is be strongly recommended unless there is extensive adhesion. The patient is placed in a modified lithotomy position. The chief surgeon operates between the legs, with two assistants on each side (Fig. 1). The procedure starts from subumbilical cut down and creation of pneumoperitoneum; the insufflation pressure is kept below 10mmHg. The trocar site and the position of the handport is arranged in such a way that two operating surgeons can work together, using the four-handed technique (Fig. 2). The use of a 30° laparoscope gives a wider range of view, and its magnification allows small peritoneal deposits to be easily identified; these are often missed by preoperative imagings. In essence, laparoscopic ultrasound replaces the loss of tactile palpation and offers a means to rule out intrahepatic metastasis. It also helps to define the relationship between the tumor and the vascular structures.

As for hepatolithiasis, the segmental distribution of stones and any residual common bile duct fragment can be satisfactorily visualized by laparoscopic ultrasound. The planned resection plane can then be marked with diathermy.