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Laparoscopic liver resection assisted with radiofrequency

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Abstract

Background: Radiofrequency-assisted laparoscopic liver resection is reported.
Methods: Patients suitable for liver resection were carefully assessed for laparoscopic resection. Patient and intraoperative and postoperative data were prospectively collected and analyzed.
Results: Eighteen patients underwent laparoscopic liver resection. All operations were performed without vascular clamping and consisting of tumorectomy (n = 9), multiple tumoretcomies (n = 2), segmentectomy (n = 2), and bisegmentectomies (n = 2). Mean blood loss was 121 ± 68 mL, and mean resection was time 167 ± 45 minutes. There was no need for perioperative or postoperative transfusion of blood or blood products. One patient developed pneumothorax during surgery as a result of direct puncture of pleura with the radiofrequency probe, and 1 patient had transient liver failure and required supportive care after surgery. The mean length of hospital stay was 6.0 ±1.5 days. At follow-up, those with liver cancer had no recurrence.
Conclusions: Radiofrequency-assist laparoscopic liver resection can decrease the risk of intraoperative bleeding and blood transfusion.

Keywords: Laparoscopic liver resection; Liver resection technique; Liver tumours; Radiofrequency

Since the advent of laparoscopic cholecystectomy [1], minimally invasive procedures, performed on many organs, have been introduced in recent years [2–4]. In liver surgery, laparoscopy was initially used only for minor procedures, such as biopsy and staging of liver tumor [5,6] or fenestration of nonparasitic liver cysts [5]. However, in the last few years this technique has been increasingly used for liver resection [7–11].

Liver resection remains a high-risk procedure with significant morbidity and mortality rates. Intraoperative bleeding and perioperative blood transfusion are usually considered to be the major reasons affecting these rates [11–13]. Various methods–including the use of cavitron ultrasonic aspirator (CUSA), harmonic scalpel, bipolar forceps, or scissors–are now available for minimizing intraoperative blood loss related to parenchyma transection in both open and laparoscopic resections [14–16]. These methods are usually used in combination with hepatic pedicle clamping to achieve satisfactory intraoperative haemostasis because none of these techniques is effective in preventing intraoperative bleeding on its own. Despite these modern technologies, hemorrhage still remains the main problem frequently encountered during transaction of liver parenchyma [17]. In laparoscopic liver surgery, access to the liver is limited through, and control of intraoperative bleeding is inevitably difficult. Conversion to an open procedure is often imminent to achieve hemostasis and to complete resection when bleeding occurs.

Radiofrequency-assisted liver resection was originally described for "bloodless" liver resection without the need for vascular clamping or the use of suture, surgical knots, or clips [18]. Because of this unique feature, it would seem ideal to use this device for laparoscopic liver resection. The current study examined the feasibility and results of this technique in laparoscopic liver resection.

Patients and Methods

Between November 2001 and April 2004, a total of 321 patients were deemed suitable for liver resection. However,

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Table 1
Patient clinical details

Mean age in years (range)	55 (21–83)
Sex (M/F)	12/6
Diagnosis	
Metastases	10
Colorectal cancer	9
Lung cancer	1
Hepatocellular carcinoma	5
Child-Pugh grade (A/B)	4/1
Focal nodular hyperplasia	2
Hemangioma	1
Mean tumor size (mm)	32 ± 23
Location of tumor (segment)	
II/III	9
IV	3
V/VI	5
VI/VII	2

only 18 patients were included for laparoscopic resection based on our selection criteria of good general condition (American Society of Anesthesiologists (ASA) score 1 or 2), normal liver function tests, and tumor located in the peripheral segments of liver (stages II, III, IVb, V, or VI) (Table 1). The surgeries were performed at the hepatopancreaticobiliary units of Hammersmith Hospital (London, UK) and the Hospital Universitaire de Hautepierre (Strasbourg, France).

After general anesthesia was inducted, open technique to creation the pneumoperitoneum was used to avoid possible damage to intra-abdominal organs as a result of adhesions from previous abdominal surgery. Pneumoperitoueum was maintained throughout the procedure on a high flow rate with carbon dioxide at a pressure of 12 mm Hg. The operation was performed using three 12-mm ports and one 5-mm port along the subcostal margin, depending on the site of the liver tumor. In general, two 12-mm ports were inserted to 1 side and one 12-mm ports and one 5-mm port to the other. Any perihepatic and peritoneal adhesions related to previous laparotomy were divided to allow examination of the entire abdomen for either local recurrence at the primary site of previous colorectal resection or for peritoneal deposits. Afterward, intraoperative ultrasound (IOUS) was performed in all cases to obtain further information on the extent of disease and the anatomic relationship between the tumor and the surrounding portal pedicles and hepatic venous branches.

Radiofrequency (RF)-assisted liver resection technique has been described previously for the open approach [19]. In brief, a "cooled tip" RF probe with a 500-kHz RF generator (model RFG-3D; Radionic Europe, Wettdren, Belgium) was used to produce coagulative necrosis along a line of intended division of liver parenchyma without vascular clamping of either portal triads or major vessels. Compared with the open approach, in which the whole resection line was coagulated before cutting, the liver parenchyma was progressively transected with a pair of scissors after each RF application in the laparoscopic approach. The RF probe, which measured 25 cm long, was introduced either percutaneously or by way of a 5-mm port. For lesions located at the inferior part of liver that were accessible through a 5-mm port, the probe was introduced by way of this port. However, for tumours located over the dome or the posterior part of liver beneath the rib cage, percutanenous insertion of the probe in the intercostal space directly over or inferior to the tumor was done. Before starting RF, IOUS was used to mark the resection margin with diathermy on the surface of liver. Then the RF probe was inserted first to the most difficult part of the intended plane of transection in the deepest and farthest areas from the surface of liver, under the guidance of IOUS, to ensure correct positioning of the probe to avoid any inadvertent damage to any vascular or vital structures and at the same time allow an adequate resection margin. This was done before starting RF to prevent interference of ultrasonic images from RF. To complete the transection of liver parenchyma along the ablated plane, a pair of laparoscopic dissection scissors was used. Finally, extraction of the specimen was done, whenever possible, with an endobag (Endocatch, Autosuture, United States Surgical Cooperation, Norwalk, CT) by enlarging a port-site incision. For a large specimen that would not fit in an endobag, 2 adjacent ports were jointly opened to retrieve the tissue through this open incision. A 20-French gauge drain (Smiths Medical International Ltd., Hythe, Kent, UK) was routinely placed close to the resection margin.

Patient details, including preoperative and postoperative liver function tests, haemoglobin, and platelet levels were recorded. The following measurements and data were also documented: operative time, defined as the time taken to complete surgery; ablation and transection time, defined as the time taken to complete liver parenchyma transection after radiofrequency ablation; use or not of the Pringle manoeuvre; total blood loss as measured from the amount of aspirates in vacuum suction; and transfusion requirement with either red blood cells or blood products, including platelets, fresh frozen plasma, or albumin. Postoperative data, including morbidity, mortality, and length of hospital stay, were also collected.

Results

Eighteen patients were considered suitable for liver resection; the mean age of 55 – 12 years. Characteristics of tumours and surgical procedures are listed in Tables 1 and 2. Two patients with a final histologic diagnosis of focal nodular hyperplasia underwent resection because of a preoperative uncertainty of diagnosis on biopsy. Three patients with colorectal liver metastases (16%) had their resection converted to open soon after laparoscopy because of extensive adhesions around the liver from previous colonic surgery

Table 2
Type and results of resection

Type of resection (n)	
Tumorectomy	9
Multiple tumorectomies	2
Segmentectomy	2
Bisegmentectomies	2
Mean blood loss (mL)	121 ± 68
Mean operative time (min)	213 ± 59
Mean resection time (min)	167 ± 45
Mean length of stay (days)	6 ± 1.5