Laparoscopic hepatic resection for hepatocellular carcinoma

Retrospective study of 12 patients

Axèle CHAMPAULT, Ibrahim DAGHER, Corinne VONS, Dominique FRANCO

Service de chirurgie générale et digestive, Hôpital Antoine Béclère, Clamart.

SUMMARY

Aims — To assess the results of laparoscopic liver resection for hepatocellular carcinoma.

Patients and methods — From 1998 to 2003, 12 laparoscopic liver resections for hepatocellular carcinoma were performed.

Results — There were no operative complications and no deaths. Conversion to laparotomy was required in one patient (8%) and transfusion in three patients (25%). One patient died of liver failure. Postoperative complications occurred in three patients (25%): trocar site bleeding, cardiac failure and biliary collection. The mean hospital stay was 5 days. No ascites and no transient liver failure occurred. During the mean follow up of 15 months the recurrence rate was 45.5%. No port site or peritoneal metastases were observed. Treatment of recurrence was second resection in two patients and microwave coagulation therapy in two other patients. Mean survival was 24 months.

Conclusion — Laparoscopic liver resection is feasible in hepatocellular carcinoma if the tumor is unique, smaller than 5 centimeters and located in the left lateral segments or in the anterior or inferior segments of the right liver. Postoperative morbidity is low and long-term results seem to be similar to laparotomy.

Introduction

Laparoscopy is used for an increasing number of abdominal procedures, but has been limited for liver surgery for several reasons: 1) liver surgeons have not been in the forefront for the laparoscopic approach; 2) the laparoscopic approach to the entire liver remains complex; 3) the proximity of the great vessels raises an important risk of a serious vessel wound; 4) laparoscopic section of the liver requires the development of adapted procedures. Furthermore liver surgery is mainly performed in cancer patients and for many years laparoscopy was not considered adequate for cancerological resection because of the risk of regional dissemination [1, 2]. Hepatocellular carcinoma, particularly in cirrhosis patients, is theoretically a good indication for laparoscopy. Most tumors are small and discovered during screening examinations in patients with chronic liver disease [3, 4]. Laparotomy for resection requires a wide abdominal approach with the risk of ascites and its complications. Few series of laparoscopic resection of hepatocellular carcinoma have been reported [5-13]. The purpose of this study was to evaluate the feasibility of this approach and to report results of laparoscopic resection of the liver for hepatocellular carcinoma.

Patients and methods

Patients

From February 1998 to October 2003, twelve patients underwent laparoscopic hepatectomy for hepatocellular carcinoma at the Antoine-Béclère Hospital (Clamart, France). There were 11 men and one woman, mean age 68.9 years (range 44-78 years); mean ASA score 2.5. Eleven patients had an underlying liver disease (alcoholic cirrhosis in 6, posthepatitis cirrhosis in 3, hemachromatosis in 2). One patient was Child Pugh C score 10. The laparoscopic approach was chosen because of tumor accessibility. During the same period, hepatic resections were performed by laparotomy for hepatocellular carcinoma in 82 patients.

In seven patients, the tumor was discovered during surveillance of known liver disease or cirrhosis. In two patients, the liver nodule was discovered during treatment for prostate cancer. For the three other patients, signs leading to the discovery of the hepatic tumor were abdominal pain (one patient), perturbed liver tests (one patient), and malaise (one patient).

RÉSUMÉ

Traitement laparoscopique du carcinome hépatocellulaire. Etude rétrospective sur 12 cas

Axèle CHAMPAULT, Ibrahim DAGHER, Corinne VONS, Dominique FRANCO

(Gastroenterol Clin Biol 2005;29:969-973)

Objectifs — Evaluer les résultats de la résection hépatique par laparoscopie du carcinome hépatocellulaire.

Malades et méthodes — De 1998 à 2003, 12 hépatectomies par laparoscopie ont été réalisées pour un carcinome hépatocellulaire.

Résultats — Il n’y a pas eu de complication, ni de mortalité peropératoire ; une conversion (8 %) et trois transfusions (25 %) ont été nécessaires. En période post-opératoire immédiate, un patient est décédé d’une défaillance multiviscérale, et trois autres (25 %) ont présenté une complication : une hémothorax sur un orifice de trocart, une insuffisance cardiaque par trouble aigu du rythme et une collection de la tranche. La durée d’hospitalisation médiane a été de 5 jours. Aucune ascite ni insuffisance hépato-cellulaire n’ont été observées. Le taux de récidive a été de 45,5 %, en moyenne 15 mois après l’intervention. Aucune récidive péritonéale ou sur un orifice de trocart n’a été constatée. Les récidives ont été traitées chirurgicalement dans 2 cas et par radiofréquence pour 2 autres malades. La médiane de survie des malades était de 24 mois.

Conclusion — Chez les malades ayant un carcinome hépatocellulaire du lobe gauche et des segments antérieurs ou inférieurs, unique et de petite taille (< 5 cm), la résection hépatique laparoscopique est faisable avec un faible risque de complications et des résultats à long terme identiques à ceux de la laparotomie.
Preoperative laboratory results are summarized in table I. Patients were reviewed at consultation visits one and three months after surgery then again every six months for liver tests (including α-FP) and morphological studies (liver scan).

One patient was given adjuvant intra-arterial injection of lipiodol (Lipiocis®, Guerbet SA, France) as part of a prospective protocol.

Operative technique

Hepatic resections performed are presented in table II.

All procedures were conducted under general anesthesia. The patient was positioned in dorsal decubitus when the tumor was situated in the left liver and in a slightly left lateral decubitus when the tumor was situated in the right liver. Lower limbs were spread apart and the upper limb homolateral to the tumor was along the body. Pneumoperitoneum was achieved by mid-line open laparoscopy at the umbilicus or just above depending on the patient’s morphology. A pressure of 9 to 11 mmHg was maintained throughout the procedure. A 0° optic was introduced via the umbilical trocar. In general five trocars were necessary, four placed in a semi-circle around the liver and one at the upper part of the epigastrium.

Anatomic resection was achieved whenever compatible with the residual liver volume. For hepatectomy and left lobectomy, primary dissection of the left hepatic vein was followed by extrahepatic dissection of the glisson pedicles. For right hepatectomy, the right glisson pedicle alone was sectioned before section of the parenchyma. The right hepatic vein was approached at the end of the parenchymal section. For segmentectomy, the glisson pedicles were spared. Section of hepatic parenchyma was performed with a harmonic cauterity (Ultracision®, Ethicon) for nine resections and an ultrasound cautery (Satelec®) for the three others. During parenchymal section, hemostasis and biliostasis were achieved by bipolar coagulation and use of resorbable clips for larger vascular or biliary elements. The hepatic pedicle was not clamped.

Major right and left hepatic veins were sectioned with an automatic stapler (Endo GIA roticulator vasculaire®, Tyco).

Table I. – Biological features of patients before laparoscopic liver resection for hepatocellular carcinoma.

<table>
<thead>
<tr>
<th>Biological data</th>
<th>Mean</th>
<th>Number of patients outside the normal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total bilirubin (mg/L) (N &lt; 10)</td>
<td>10.5 (4-24)</td>
<td>5</td>
</tr>
<tr>
<td>Gamma GT (UI/L) (N &lt; 35)</td>
<td>170.2 (24-660)</td>
<td>10</td>
</tr>
<tr>
<td>ALAT (UI/L) (N &lt; 35)</td>
<td>34.4 (12-72)</td>
<td>4</td>
</tr>
<tr>
<td>ASAT (UI/L) (N &lt; 30)</td>
<td>33.3 (14-67)</td>
<td>4</td>
</tr>
<tr>
<td>Prothrombin index (%) (N : 80-100)</td>
<td>83% (20-100)</td>
<td>2*</td>
</tr>
<tr>
<td>Alpha-feto protein (ng/mL) (N &lt; 20)</td>
<td>1**</td>
<td></td>
</tr>
</tbody>
</table>

* one patient on anticoagulants for thromboembolism
** 2 results not available

Table II. – Localization and size of tumors, type of liver resection, surgical margins and recurrence in 12 patients undergoing laparoscopic liver resection for hepatocellular carcinoma.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Localization</th>
<th>Size (mm)</th>
<th>Type of resection</th>
<th>Surgical margin (mm)</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VI</td>
<td>32</td>
<td>VI</td>
<td>14</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>IV</td>
<td>50</td>
<td>IV anterior</td>
<td>8</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>23</td>
<td>III</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>V</td>
<td>40</td>
<td>V</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>III</td>
<td>15</td>
<td>III</td>
<td>10</td>
<td>Death d11</td>
</tr>
<tr>
<td>6</td>
<td>V</td>
<td>18</td>
<td>V atypical</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>V-VI</td>
<td>25</td>
<td>V-VI atypical</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>V</td>
<td>10</td>
<td>V atypical</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>III/V</td>
<td>45/12</td>
<td>Left lobectomy + radiofrequency</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>IV/VI/VII*</td>
<td>50</td>
<td>Right hepatectomy</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>III</td>
<td>60</td>
<td>Left lobectomy</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>V</td>
<td>45</td>
<td>V-Vi</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

*hepatocellular carcinoma associated with two adenomas on the definitive surgical specimen
After checking the resection margin, the operative specimen was extracted in a sack through a trocar port widened or a short Pfannenstiel incision. None of the 12 patients had abdominal drainage.

Cholecystectomy was associated in three patients. In the patient with two tumors, one in segment III and one in segment V, left lobectomy was associated with radiofrequency treatment of a nodule in segment V.

**Pathology examination**

All surgical specimens were examined in the fresh state, cut in 10 mm slices and documented photographically. The shortest distance between tumor and the resection margin was noted. Gross examination included search for tumor extension or infiltration, presence of a capsule and its invasion, satellite nodes, and invasion of the portal or suprahepatic veins.

**Statistical analysis**

The actuarial method was used to determine survival. Means were compared with the chi-square test. P greater than 0.05 was considered significant.

### Results

#### Intraoperative results

There were no operative complications and no deaths. Conversion to laparotomy was required because of insufficient progression of the hepatic section in one patient (8%) undergoing resection of segments V and VI. Three patients (25%) required transfusion, during segment III resection in one and atypical resection of the right liver in two. Intraoperative bleeding in these three patients, estimated 700-1200 ml, was controlled laparoscopically.

#### Postoperative complications

Postoperative mortality was 8%. One patient died on day 11 after segment III resection due to multiple organ failure. This patient, who had cirrhosis (Child Pugh score 10), developed kidney and liver failure the second postoperative day.

Early postoperative complications were noted in three patients (25%). Bleeding at a trocar port required transfusion of two packed red cell units and ceased spontaneously. One patient developed complete cardiac arrhythmia leading to acute heart failure. A subphrenic biliary collection which developed in a patient who had undergone resection of segments V and VI was drained under computed tomographic guidance; bacteriology was negative. There were no clinical signs of ascites in any of the patients during their hospital stay and varicose hemorrhage was not noted.

Median hospital stay was five days (range 3-33 days).

Patients attended follow-up consultations at one month and three months then every six months. An asymptomatic collection on the liver section was noted on the computed tomography in two patients (18.2%) at one month. Drainage was not required.

None of the patients developed ascites or liver failure during the follow-up period.

#### Pathology results

The pathology diagnosis was hepatocellular carcinoma in ten patients and hepatoblastangiocarcinoma in two. Mean tumor size was 33.5 mm (range 12-60 mm). Pathology results are summarized in table III.

#### Recurrence (table II)

Five patients developed a recurrent tumor (45.5%) during the follow-up a mean 15 months after hepatectomy (range 7-24 months).

---

#### Table III – Histological features of 12 laparoscopic resected hepatocellular carcinomas.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capsule</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Rupture of the capsule</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Vascular emboli</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Satellite nodes</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

The recurrent tumor was located in the liver in all five patients, close to the cut margin in one. There were no cases of peritoneal recurrence or invasion of the trocar port. Among the five patients with recurrence, three developed a second recurrence (two hepatic and one isolated bone) on average 19 months after treatment of the first recurrence (two repeated hepatic resections and one percutaneous radiofrequency ablation).

On average, the margin of healthy parenchyma between the tumor and the resection cut measured 8.9 mm (range 1-20 mm) and was greater than 5 mm in 8 (67%) (table II).

#### Treatment of recurrence

Two patients underwent surgical treatment of recurrence by repeated laparotomy for hepatic resection. One was living without recurrence three years after the second resection. One other patient developed bone metastases eight months after the second hepatic resection. It was treated by radiotherapy. This patient died three years after discovery of the hepatocellular carcinoma.

Two patients were treated by radiofrequency ablation, one percutaneously. The postoperative period was uneventful. Two years after this treatment, the percutaneously treated patient developed a new hepatic recurrence treated by chemo-embolization. The other patient was treated by surgical radiofrequency ablation for a recurrence located on the hepatic dome. This patient developed septic shock postoperatively and died in a context of multiple organ failure.

The recurrence was not treated in the last patient due to contraindications for repeated surgery or radiofrequency ablation.

#### Survival

Four patients died. Two patients died of heart failure during follow-up, one eight months and another thirteen months after surgery. The liver scans performed at four and ten months post-resection did not reveal any evidence of recurrence.

The two other patients died during the course of the treatment for recurrence (one after surgical treatment and one after radiofrequency treatment).

Median survival of all patients was 24 months (1-41 months). Three patients with recurrence were still alive three years after hepatectomy.

The overall and recurrence-free actuarial survivals are presented in figures 1 and 2.

#### Discussion

The purpose of this study was to evaluate the results of laparoscopic hepatectomy for hepatocellular carcinoma.
In this series, like others [14, 15], there were no intraoperative complications or deaths. The conversion rate was low (one patient, 8%) and similar to earlier reports (about 14% [16, 17]). The localization of the tumor in the patient who was converted, high in the upper part of segments V and VI, made the laparoscopic approach and resection difficult. Tumors of the left lobe and the anterior and inferior segments (IV, V, VI) [5, 8-9, 18-20] with a small diameter (< 5 cm) are currently the most accessible to laparoscopic resection. In our series, tumor size ranged from 12 to 60 mm. Exposure and resection of posterior and superior tumors (segments I, VII, VIII) remains difficult [8, 10, 19]. With improved instruments and optics, and correct patient positioning, or with an associated thoracoscopy, it will undoubtedly be possible to access such tumors laparoscopically. Studies designed to evaluate the benefit of laparoscopy associated with manual assistance, particularly for posterior tumors of the right liver, are currently in course [21, 22].

It has been suggested that laparoscopic liver resection, particularly in cirrhotic patients, is associated with greater risk of bleeding [10]. In this study as in others [14, 16, 18] blood loss was not greater than observed with laparotomy even though hepatic pedicle was not clamped. Use of hepatic clamping to reduce the risk of intraoperative bleeding is controversial [6, 7, 11, 12, 19, 23]. It is more difficult to achieve by laparoscopy than by laparotomy. In addition, the hemodynamic consequences of clamping a hepatic pedicle with pneumoperitoneum is highly controversial [24, 25]. Bipolar coagulation, as well as new techniques for section-coagulation such as thermofusion and/or harmonic cautery facilitate parenchyma transection [26, 27] and contribute to reducing blood loss [5, 20, 28]. It is generally accepted that intraoperative transfusion plays an important role in the risk of postoperative morbidity [29, 30], recurrence, and patient survival [23].

We did not observe any cases of air embolism with clinical impact in this series. This complication is exceptional but can be a dramatic complication of peritoneal inflation [5, 12, 18, 20, 31, 32]. The risk can be limited with simple precautions (low pressure, automatic stapler for the major vessels, suspension of the abdominal wall) [5, 10, 20]. The clinical impact of carbon dioxide embolism is limited due to its solubility compared with air or oxygen [31-34].

One cirrhotic patient in this series developed severe liver failure, then multiple organ failure despite very limited liver resection (segment III). This patient was the only one in our series with poor liver function preoperatively. Although suggested by some [6], laparoscopy is not a solution for patients considered inoperable by laparotomy. For other patients, there is little or no risk of clinical ascites or liver failure after the procedure. Morbidity has ranged from 10 to 40% [35, 36] after even limited laparotomic hepatectomy in cirrhotic patients. Laparoscopy appears to reduce the risk of postoperative complications in cirrhotic patients by limiting the trauma to the abdominal wall [4-7, 14, 18, 20].

The frequency of postoperative complications (25%) was not higher than observed after laparotomic liver resection. Two patients (16.6%) developed a complication directly related to the procedure but did not require reoperation (port site bleeding and subphrenic collection).

The risk of dissemination is often put forward as an argument against laparoscopy for cancerological surgery [1, 2]. This is not confirmed by our results. First, we did not observe any case of peritoneal carcinomatosis nor recurrence at the port sites. Secondly, the safety margin was quite satisfactory in most of the patients. Overall and recurrence-free survivals were similar to that generally observed for hepatocellular carcinoma treated by laparotomic hepatectomy [37-39]. These findings confirm those currently observed in clinical practice for other cancers, particularly colorectal cancer [40, 41] when the rules of cancerological surgery are respected, particularly the absence of manipulation or traumatic rupture of the tumor and a wide safety margin.

These results suggest that laparoscopy can provide results similar to that obtained with laparotomy [37-39] for resection of hepatocellular carcinoma. They should be confirmed in larger series and prospective studies. Laparoscopy could be an important contribution limiting the operative risk and postoperative complications [5-7, 14, 18-20] and shortening hospital stay [11, 13, 18, 19]. This method avoids the risk of bide formation in patients who may have to undergo repeated resections or transplantation.

REFERENCES


