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HOW I DO IT

Laparoscopic Enucleation of Liver Tumors. Corkscrew Technique Revisited

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Background: Enucleation of small lesions located near the hepatic surface can be achieved with low morbidity and mortality. This article describes a simple laparoscopic technique for enucleation of liver tumors.
Methods: After inspection and intraoperative ultrasonography, Glisson's capsule is marked with eletrocautery 2 cm away from the tumor margin. Ultrasonography is used to ascertain surgical margin right before liver transection. Hemihepatic ischemia is applied and marked area is anchored by stitches. The suture is held together by metallic clips and upward traction is performed, facilitating the transection of the parenchyma and correct identification of vascular and biliary structures.
Results: This technique has been successfully employed in six consecutive patients. There were four men and two women, mean age 50.3 years. Four patients underwent liver resection for malignant disease and two for benign liver neoplasm. Pathologic surgical margins were free in all cases and mean hospital stay was 2 days. No postoperative mortality was observed.
Conclusion: This technique may facilitate laparoscopic nonanatomical liver resection and reduce risk of positive surgical margins. It is also useful in combination with anatomical laparoscopic liver resections such as right or left hemihepatectomies in patients with bilateral liver tumors as occurred in one of our patients.
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KEY WORDS: liver; laparoscopy; surgery; anatomy; ultrasonography; technique

INTRODUCTION

Recent advances in laparoscopic techniques resulted in a growing indication for laparoscopic liver resection [1–5]. Most performed laparoscopic liver procedures are right or left hemihepatectomies, left lateral segmentectomy and nonanatomical liver resections [3].

New techniques using intra-hepatic control of Glissonian pedicles allowed the development of segment-based laparoscopic liver resections [6]. Nevertheless, there is still a place for nonanatomical liver resections. Enucleation of small lesions located near the hepatic surface can be achieved with low morbidity and mortality. However, oncological prognosis can be compromised by positive resection margins.

Recently, Santibañes et al. [7] described a simple technique for enucleation of liver metastasis, the so called ''corkscrew technique''. Santibañes et al. stated ''The corkscrew technique allows the lesion to be held as if it were in a basket and to be pulled upward, with an even traction, allowing the identification and control of the vascular and biliary elements. Therefore, it facilitates the exposure, which develops in an excellent oncological margin''.

Using the same concept, this article describes a laparoscopic technique for enucleation of liver tumors using a modified corkscrew technique.

OPERATIVE TECHNIQUE

The patient is placed in a supine position with the surgeon standing between patient's legs. An orogastric tube is inserted and removed at the completion of the procedure. This technique uses five trocars. Using an open technique, a 12-mm trocar is placed 3 cm above the umbilicus; through this port, a 10-mm 30° angled laparoscope is introduced. Pneumoperitoneum is established at a pressure of 12 mmHg. The other four trocars are located according to the localization of the tumor (left or right liver) as shown in Figure 1. The round ligament is transected using laparoscopic coagulation shears (LCS; Ethicon Endo Surgery Industries, Cincinnati, OH, USA). Inspection of the abdominal cavity and ultrasound liver examination are performed.

After identification of the lesion by inspection and intraoperative ultrasonography (Fig. 2a), Glisson's capsule is marked with eletrocautery 2 cm away from the tumor margin. The marked area is checked by ultrasonography to ascertain surgical margin right before liver transection (Fig. 2b). Hemihepatic ischemia [8] (hemi-Pringle maneuver) is then applied (Fig. 2c and d), according to location of the tumor and marked area is anchored by stitches with caution in order to prevent the needle from entering the tumor (Fig. 3). The suture is held together by metallic clips and upward traction is performed (Fig. 3), facilitating the transection of the parenchyma and correct identification of vascular and biliary structures. Parenchymal transection is performed with laparoscopic coagulation shears. Whenever necessary, metallic clips or stitches are applied to achieve vascular and biliary control. The control of the surgical margin can be verified by intraoperative ultrasonography during parenchymal transection.

All these steps are performed without hand assistance. The specimen is extracted through a suprapubic incision inside a plastic retrieval bag. Abdominal drain is not used routinely.

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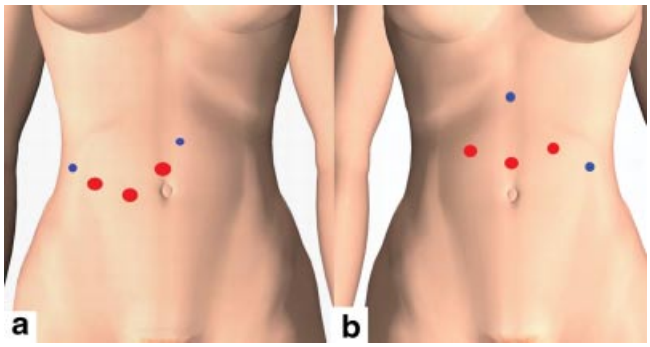

Fig. 1. Diagrams of trocar placement for laparoscopic liver resections. Three 12 mm trocars (red) and two 5 mm trocars (blue) are needed. **(a)** Right-sided liver resections. **(b)** Left-sided liver resections. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

RESULTS

This technique has been successfully employed in six consecutive patients with liver tumors. There were four men and two women, mean age 50.3 years. Two patients underwent liver resection for colorectal liver metastasis, two for hepatocelular carcinoma, and two for liver cell adenoma. Liver tumors were situated on the right liver in five patients. One patient presenting bilobar liver metastasis underwent enucleation of left liver metastasis and laparoscopic right hepatectomy concomitantly. Pathologic surgical margins were free in all cases. Mean hospital stay was 2 days. No postoperative mortality was observed. One patient with liver cirrhosis developed postoperative ascites that was easily controlled with oral diuretics.

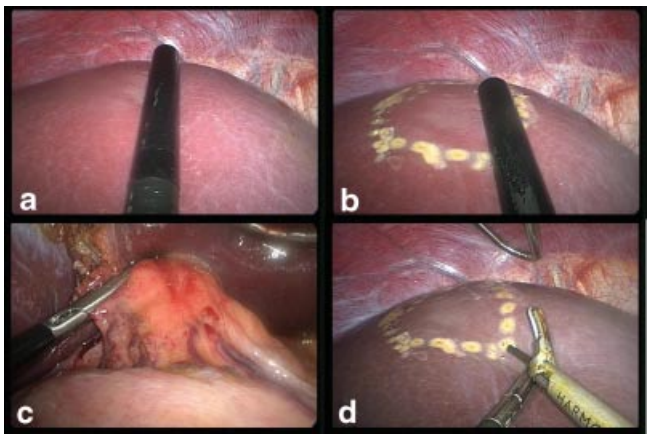

Fig. 2. Tumor location. **(a)** Intraoperative laparoscopic ultrasonography is performed and the exact tumor location is established (in this case in segment 8). **(b)** After demarcation, ultrasonography probe is placed over marked area to check future line of liver transection for adequate margin. **(c)** Selective right hemihepatic ischemia is obtained with a vascular clamp. **(d)** Liver transection begins with laparoscopic coagulation shears. Note that liver is now clearly ischemic. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

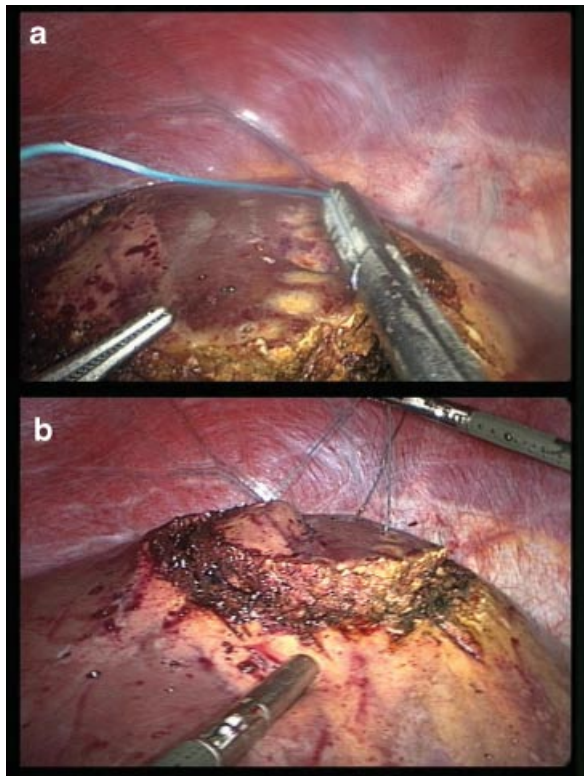

Fig. 3. Laparoscopic corkscrew technique. **(a)**After initial transection, marked area is evenly anchored by stitches. **(b)** Upward traction is performed, facilitating parenchymal transection. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

DISCUSSION

Although anatomical resection, which allows a better clearance between tumor deposits and the cut section of the liver, is recommended as a standard procedure for metastatic liver cancer, nonanatomical resection is quite feasible for small metastases with little risk of microscopic local invasion [9,10]. Indeed, liver resection of peripheric small lesions is feasible and can be done with minimum morbidity and mortality rates [7].

During enucleation of small superficial liver neoplasms, the difficulty to pull the lesion, together with the bleeding in the cutting line, produces lack of exposure and vascular control, which may ultimately compromise tumor margin [7]. This fact may be even worse during laparoscopic surgery due to loss of tactile sensation. The laparoscopic corkscrew technique may overcome these difficulties by allowing upward traction of the surgical specimen. Intraoperative ultrasonography is essential because it permits clear definition of tumor margins. Circumferential and deep margins can be established before and during parenchymal transection.

The present technique is feasible in every liver segment but especially useful for resection of tumors located in superior liver segments such as S7, S8, S4, and S2. We have been used this modified corkscrew technique for nonanatomical liver tumor resections since 2007 and surgical margins were free in all cases (Fig. 4).

According to De Matteo et al. [11], traction of the specimen during division of the liver parenchyma tends to produce a fracture at the interface of the fragile soft liver tissue and the hard liver tumor. Corkscrew technique allows an even distribution of the traction avoiding fracture of the surrounding tissue. Because of lack of vascular control, hemorrhage commonly occurs and may obscure the plane of

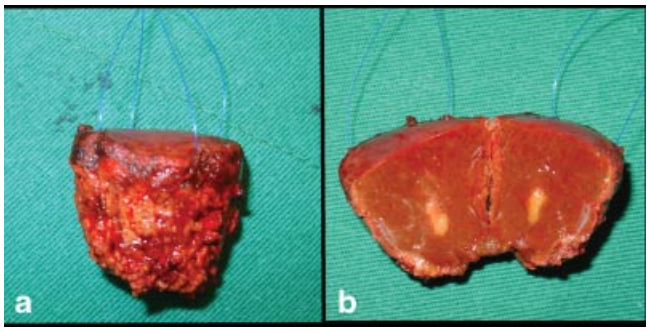

Fig. 4. Laparoscopic corkscrew technique—Surgical specimen. **(a)** Surgical specimen—liver metastasis from segment 7. **(b)** Photograph of specimen shows free deep and lateral margins. [Color figure can be viewed in the online issue, available at www.interscience.wiley.com.]

the intended parenchymal transection, compromising surgical margin. In order to prevent bleeding in the site of enucleation we advocate the use of selective hemihepatic ischemia that is a simple and easy maneuver that can be performed during laparoscopy [8].

Corkscrew laparoscopic technique is also useful in combination with anatomical laparoscopic liver resections such as right and left hemihepatectomies in patients with bilateral liver tumors as occurred in one of our patients, decreasing the risk of postoperative hepatic failure.

We believe that the described technique facilitates laparoscopic nonanatomical liver resection and reduces the risk of positive surgical margins.

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