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Case Report Open Access

"Combined Laparoscopic and Trans-Thoracic Approach" for Limited Liver Resections

Salceda Juan*, Laurent Alexis, Cherqui Daniel, Azoulay Daniel and Tayar Claude

Digestive and Hepato-Biliary Surgery Department, Henri Mondor Hospital, Paris-Est Créteil University, France

Abstract

Background: Since the very first report and through to the last two decades, laparoscopy has demonstrated to be an effective tool for liver surgery, especially limited resections. Despite increasing experience worldwide and the multitude of instruments and energy based devices for parenchymal transection, some locations remain difficult for limited laparoscopic resections. Posterior and upper right segments of the liver (segments 7 and 8) are still tricky to be exposed properly while using a standard laparoscopic approach. We present a new technique with a Combined Laparoscopic and Trans-Thoracic Approach (CLTTA) to reach difficult locations in the liver enabling limited resections while conserving the advantages of minimally invasive surgery.

Methods: Three patients underwent limited liver resection through a CLTTA. The first patient had liver metastasis of colonic cancer, the second an inflammatory liver adenoma and the third a liver nodule suspected to be a HCC with underlying cirrhosis. All lesions were located between segments 7 and 8.

Results: All procedures were performed using CLTTA. Four ports were placed in the abdomen and two supplementary 5 mm ports were placed through the right pleural cavity.

Parenchymal transection was done in every case using either harmonic scalpel (Ultracision, Ethicon Endo-surgery, Cincinnati, OH) or vessel sealing device (Ligasure, Covidien-Valleylab, Boulder, CO) for the first two superficial centimetres and then Ultrasonic Surgical Aspirator (Sonosurg, Olympus, Tokyo, Japan) for deeper transection. Haemostasis was achieved using bipolar coagulator and clips when necessary. Chest tube was left in place for two days after surgery. No patient was transfused. No conversion, morbidity or mortality was observed.

Conclusions: We report our early experience with this new technique that seems to be feasible and safe for the laparoscopic limited resections of upper and posterior right segments of the liver. Further experience is needed in order to confirm these data.

Keywords: Combined approach; Laparoscopic liver resection; Trans-thoracic laparoscopy; Limited liver resections

Introduction

Since the very first report [1] and over the last two decades, laparoscopic liver surgery has been increasingly used [2-4]. However, some locations such as right superior and posterior segments remain difficult to approach laparoscopically in case limited resection is indicated [4]. Even in trained hands and after achieving a good mobilization of the right lobe, standard straight laparoscopic tools and 30° laparoscope may not be enough to enable a proper approach to these segments. This may encourage the laparoscopic surgeon to perform a major resection like a standard laparoscopic right hepatectomy which can be considered an over treatment in some indications. Other surgeons might stick to the indication of a limited resection and do it by an open technique. We present a new technique, the Combined Laparoscopic and Trans-Thoracic Approach (CLTTA), unpublished to our knowledge that allows a minimal access surgery in these indications.

Patients and Methods

Case 1

A 55 year-old man, BMI 24, with history of occlusive sigmoid adenocarcinoma (T3N2M1) operated by open surgery 6 months earlier in another hospital presented with synchronous liver metastasis. Patient underwent postoperative chemotherapy with FOLFOX resulting in a tumour response of 50%. Pre-operative CT-Scan and MRI showed a 25 mm lesion in segment 8 of the liver. PET-CT-Scan did not find extra hepatic disease. ACE level was normal.

Case 2

A 53 years old female, BMI 22, with no co-morbidity, was explored for right upper quadrant pain. A 50 mm lesion was detected in segment 7 of the liver. AFP and ACE levels were within normal range. Fine needle biopsy revealed inflammatory liver adenoma (Figure 1a).

Case 3

A 65 year-old man, BMI 26, with viral B cirrhosis, had a 22 mm liver nodule detected during follow up located in segment 8. CT-Scan and MRI characteristics were in favour of a HCC. AFP level was within normal range (1.8 µg/l) (Figure 1b).

Surgical Technique

The patient is positioned on the operating table in a supine position and a 45° tilt to the left side with the legs spread apart to enable the main surgeon to perform the abdominal part of the operation standing

***Corresponding author:** Dr. Juan Salceda, HPB Surgery Unit, Hospital Ramon Santamarina., Paz 1400, CP 7000, Tandil, Buenos Aires, France, Tel: 0033149814832; Fax: 0033749812432; E-mail: salcedajuan@gmail.com

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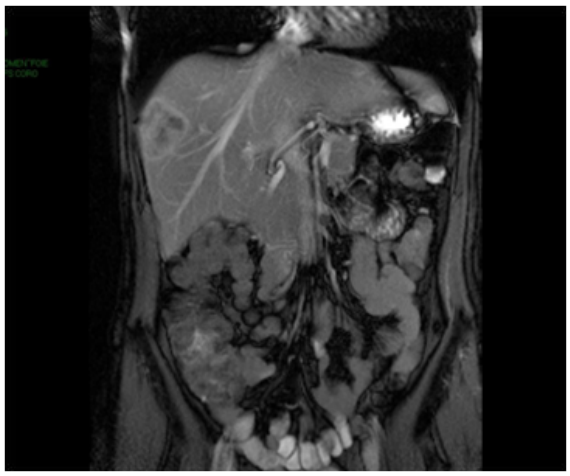

Figure 1a: MRI of liver adenoma in segment 7.

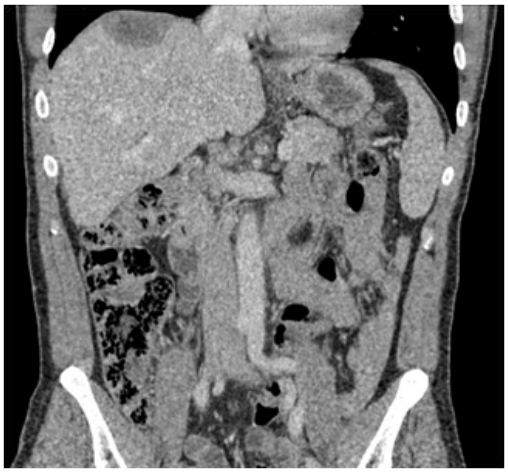

Figure 1b: CT Scan of HCC in segment 8.

between the legs. The abdominal cavity is accessed through an open pneumoperitoneum made on the upper right aspect of the umbilicus and a 12 mm optical port is inserted to create a pneumoperitoneum of 14 mm Hg. Three other abdominal ports are inserted under direct visualisation: 5 mm in the left upper quadrant, 5 mm in the right sub-costal region and a 12 mm port a hand's width to the right of the optical port for the left operating arm of the main surgeon. A full examination of the abdominal cavity is made and an intra-operative liver ultrasound performed to identify the tumour, its relations with major vascular structures and the limits of the planned resection. An opening is made in the *pars flaccida* of the lesser omentum and a tape with tourniquet placed around porta hepatis to allow Pringle manoeuvre when needed. We then start to mobilise the right lobe of the liver by sectioning the right triangular ligament as far as needed to be beyond the future transection plane. A second ultrasound examination is made at this point to verify this plane. The parenchymal transection is next started and pursued as far as possible by this trans-abdominal approach. The first superficial 2 cm of the liver are divided with the Harmonic Scalpel (Ultracision, Ethicon Endo-surgery, Cincinnati, OH) (Figure 2) or the vessel sealing device (Ligasure device, Covidien-Valleylab, Boulder, CO). Beyond this point, the transection is carried out with the use of the ultrasonic dissector (Sonosurg, Olympus and Tokyo, Japan) and the glissonian pedicules and venous branches secured and cut electively between clips.

Once the visualisation of the transection plane or the access of energy based instruments to this plane are impractical, we add two more 5 mm trocars in the 5th and 7th right intercostal spaces respectively. These trocars are inserted directly in the abdomen with a very short course through the pleural cavity to avoid pneumothorax creation. Also while inserting the thoracic trocars and to pass up the inferior part of the right lung, a non-traumatic forceps coming via the left upper quadrant trocar pushes the diaphragm against the right thoracic wall at the site of trocar insertion leaving no space for the lung to slide between the two structures. A 5mm 30° scope is then inserted in the 7th intercostal port for better visualisation and the 5th intercostal trocar used for the left operating arm of the main surgeon. The right operating arm uses alternatively the 5 mm sub-costal trocar or the 12 mm para-umbilical trocar according to the diameter of the instruments needed (Figures 3a and 3b)

At this time, the main surgeon is standing on the right side of the patient and the operating table tilted more to the patient's left side. The transection is carried out until the end using the same technique described formerly for the trans-abdominal part of the procedure. Pringle is used whenever and as much as needed (15 minutes clamping and 5 minutes release alternatively). The specimen is extracted through the abdominal optical port using a plastic bag after widening the incision if required. The right pleura and diaphragm are closed through the abdominal cavity using full thickness x shaped monofilament slowly absorbable 3/0 stitches for the two trans-thoracic trocars. The pleural cavity is afterwards completely exsufflated and a 14 F thoracic drain left in place through the 7th inter-costal port site. The abdominal cavity

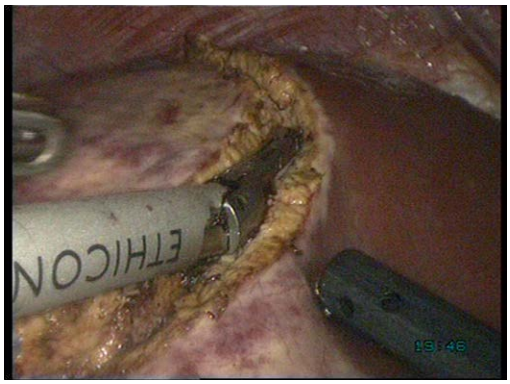

Figure 2: Beginning of parenchymal transection.

Figure 3a: Abdominal and right Trans-pleural trocars.

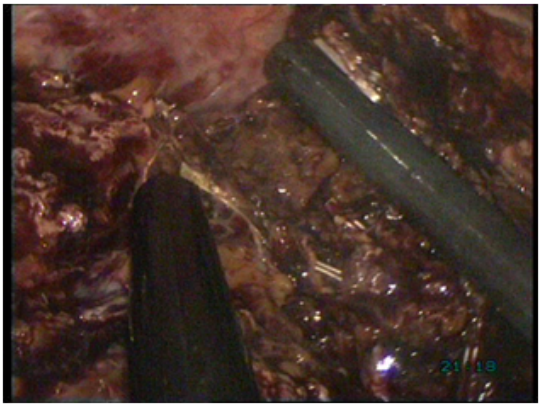

Figure 3b: Internal vision of transection.

is subsequently exsufflated after removing the tape and tourniquet of *porta hepatis*. The two 12 mm aponeurosis openings are closed with slowly absorbable monofilament 1 stitches and the skin closed with running subcuticular rapidely absorbed 3/0 stitches.

Results

All hepatectomies were non-anatomical wedge resections and performed successfully using this combined approach with no intraoperative complications or significant bleeding. Pringle manoeuvre was used for Patient 2 (5 times of 15 minutes each with 5 min declamping between Pringle) and Patient 3 (one time of 15 minutes).

No post-operative pneumothorax or pleural effusions were seen and thoracic drains were removed on the 2nd day after surgery. One abdominal drain in Patient 2 was left in place for 3 days because of the depth and extension of liver resection.

Total operation time was 270, 280 and 240 minutes respectively and hospital stay was 4, 9 and 13 days respectively.

All patients had an uneventful post-operative course.

Final study of the specimen revealed a colonic cancer metastasis, an inflammatory adenoma, and a regeneration nodule respectively in Patients 1, 2 and 3. Safety margins were 4 and 17 mm, respectively for Patients 1and 3 (Figures 4a and 4b). Patients 1 and 3 are alive and disease free 3 years and 6 months after surgery respectively.

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Discussion

Since the first case reported [1] to this time, laparoscopy has been increasingly used and demonstrated to be an effective tool in the management of liver tumours. Laparoscopic liver surgery is being used in several centres as a standard approach for benign lesions and malignancy, small wedge resections and large anatomic hepatectomies [3-10]. Even though no prospective, controlled, randomized trial has been conducted to date, several published reviews confirmed the well known benefits of the minimally invasive approach with same rates of morbidity and mortality and respect of oncological principles as in open surgery [2,8,10-12].

Experts consensus made in Louisville in 2008 [13], summarized a world position over laparoscopic liver surgery. Among its conclusions, current indications for limited laparoscopic liver resections are lesions located in segments 2 to 6.

Standard trocar position through the abdominal wall, allows having laparoscopic instruments in a convenient axis towards left and right anterior and inferior segments only, whereas for segments 7 and 8, several reasons explain the difficulties of a limited laparoscopic resection. The first one is the poor visualisation of the tumour and of the limits of the resection even though a 30° or a 45° laparoscope is used. A flexible tip laparoscope could be a solution but necessitates a learning curve on the assistant's behalf to be correctly used and gives an unusual vision of the surgical field that a surgeon should get used to work with. The second one is the working axis of the laparoscopic straight instruments especially the energy based devices that is not

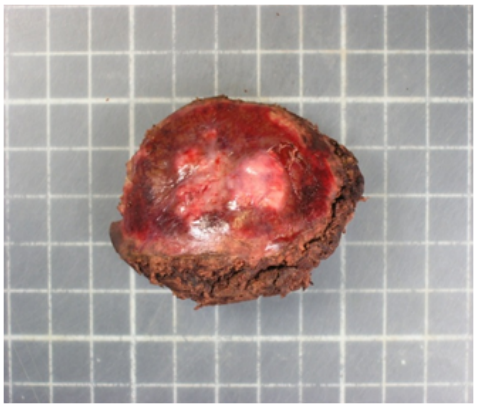

Figure 4a: Patient 1: wedge resection of liver.

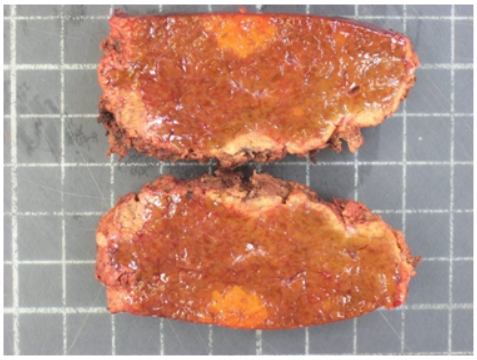

Figure 4b: Patient 3: wedge resection of HCC metastasis of colorectal cancer.

ideal for the transection plane of such high and posterior resections. The consequence of such an approach could be a compromise of the quality of haemostasis, biliostasis, and of the oncological margins. According to these recommendations and arguments, lesions located in segments 7 and 8 could be treated under laparoscopy via a major resection such as a standard laparoscopic right hepatectomy, or a limited open resection. Each one of these two ways of doing has its own disadvantages: a laparoscopic major resection is excessive in terms of parenchymal sacrifice and a limited open resection is excessive in terms of abdominal wall traumatism.

For all of these reasons, the trans-thoracic approach for liver tumors has been developed recently. Minimal-invasive trans-thoracic approach of tumors located in posterior segments of the liver was briefly reported for radiofrequency ablations under laparoscopic guidance [14,15]. Also exclusive thoracoscopy for liver tumors was already described in some series as a feasible approach for liver resection [16,17] and lately a pure video-assisted thoracoscopic hepatectomy has been described for dome liver resections [18].

By performing a pure thoracoscopic approach, one could place the instruments and the scope in the adequate axis of liver's superior and posterior segments resections but wouldn't be able to visualize and access properly the abdominal cavity, therefore providing a poor exploration of intra-abdominal organs and especially the rest of the liver. This approach also precludes a good quality intra-operative ultrasound. In addition, this approach doesn't allow a Pringle manoeuvre when needed, thus compromising the security of the resection in case of an acute bleeding during transection.

All of the aforementioned reasons led us to develop the CLTTA that allows a limited liver resection when indicated through a minimally invasive approach combining the technical advantages of the trans-thoracic route and preserving the security standards of the trans-abdominal classical laparoscopy.

Indeed, all of our three patients had a typical indication for limited liver resection, each one of them for a different reason. The first had a small colorectal metastasis that indicates a parenchymal sparing surgery to allow further resections in case of recurrence [19]. The second one also needed a limited resection because of the benign nature of the disease [20]. The third one had a liver insufficiency due to cirrhosis warranting a limited parenchymal sacrifice. In addition, radiofrequency ablation is not reasonable in superficial HCC because of the risk of cancer seeding [21, 22].

The CLTTA permits during the abdominal phase a thorough exploration of the abdominal cavity and the performance of a meticulous intra-operative liver ultrasound. Then, a tape could be placed around *porta hepatis* in case Pringle manoeuvre is needed during transection. After these preparations, liver mobilisation and a part of parenchymotomy are done via this classical laparoscopic approach. When either visualisation or working axis of energy based devices used to transect liver parenchyma become unsuitable for having an adequate tumour margin or a good control on vascular structures, the trans-thoracic approach is added. This authorizes concluding the transection while minimizing bleeding and bile leak risks without compromising oncological results.

In conclusion, CLTTA seams feasible and secure in this small series. It allows limited liver resection when indicated by a minimally invasive approach for lesions located in segments 7 and 8. Further studies are needed to confirm these data.

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