

Laparoscopic liver resection: basic skills for peripheral lesions

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Abstract: An evaluation of the literature demonstrates atypical wedge or single segment resections to be the most commonly performed laparoscopic liver procedures. Lesions that are both visible on the surface of segments 2-6 and $\leq 2-3$ cm can be resected by most surgeons holding a fundamental understanding of liver anatomy. These criteria are based on the anatomical circumstance that sectoral and segmental pedicles should not course through depths necessary to obtain negative margins for these sized and positioned lesions. Videos of laparoscopic liver resections referenced in PubMed demonstrate complex procedures that are rarely performed and assume an advanced skill set for laparoscopic dissection and transection of parenchyma and management of vascular and biliary structures. Herein is demonstrated basic skill for peripheral resections via two cases in one video, so that these procedures can be safely performed by surgeons with commonly available laparoscopic equipment.

Keywords: Hepatectomy; laparoscopy; minimally invasive; video-audio media



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Introduction

Integration of laparoscopic techniques in to hepatic surgery has been slower than in other surgical disciplines. Case-control studies have repeatedly demonstrated these techniques to be safe, have equivalent oncologic outcomes and offer many of the patient-centered benefits assumed when comparing laparoscopy with laparotomy (1,2). An evaluation of the literature demonstrates atypical (wedge) or single segment resections to be the most commonly performed procedures, and there is little doubt the number of such cases performed far outnumbers those in the literature (3). It is also fair to assume these procedures are frequently performed at non-specialized centers. By way of example, it is well recognized that laparoscopic colorectal surgery is practiced by general surgeons outside of tertiary institutions (4-6).

The 2008 Louisville Statement was initiated by the world's leading laparoscopic liver surgeons in order to set forth principles for the safe dissemination of these practices (7). According to the Statement, single lesions located in liver segments 2 to 6 that are ≤ 5 cm are candidate

lesions for laparoscopic resection at centers where there is combined expertise in liver and laparoscopic surgery. It was concluded that emphasis should be placed on avoidance of patient harm that is likely to come from inexperience rather than safety issues inherent in the procedures (7).

Recognizing laparoscopic liver surgery is currently dominated by wedge resections and likely often occurs outside of specialized centers, it behooves to disseminate safe technical practices and criteria for surgeons. Lesions that are both visible on the surface of segments 2-6 and $\leq 2-3$ cm can be resected by most surgeons holding a fundamental understanding of liver anatomy. These stricter criteria are based on the anatomical circumstance that sectoral and segmental pedicles should not course through depths necessary to obtain negative margins for these sized and positioned lesions. Larger or deeper lesions should be referred to specialists. Hepatocellular carcinoma, as opposed to metastatic lesions, should also be referred to specialized centers. This is because of the increased operative risks associated with underlying liver disease and portal hypertension, and evidence these lesions should be resected inclusive of the segmental pedicle to achieve better



Video 1 Laparoscopic liver resection: basic skills for peripheral lesions.

outcomes (8-10).

A PubMed search for the terms *laparoscopic liver* and *video* demonstrates many films of complex resections such as hemi- or extended hepatectomy, posterior segmental resection, or involving biliary reconstruction. Though instructive (and often elegant), these rarely performed laparoscopic procedures are not for the generalist and assume a skill set for laparoscopic dissection and transection of liver parenchyma and management of vascular and biliary structures (11). Herein is demonstrated basic skill for peripheral resections via two cases (*Video 1*), so these procedures can be safely performed by surgeons with commonly available laparoscopic equipment, and a nominal learning curve.

Technical points

Operative planning should be based on recent triple phase cross sectional imaging that demonstrates lesion location in relation to the portal veins (i.e., pedicles) and hepatic veins. Review of images with a radiologist will be helpful. The surgeon must be able to visualize the lesion on cross-sectional imaging to be superficial if no laparoscopic ultrasound probe is available, and confirm a safe margin can be obtained without damaging the pedicles or encountering large hepatic vein tributaries before proceeding to the operating room. The patient should be classified as Child-Pugh A.

At least one 10-12 mm trocar is necessary for specimen extraction at the conclusion of the case, and a 10 mm

30° scope unquestionably allows for better visualization. Trocars should provide triangulation about the lesion to be resected. Two-to-three 5 mm trocars and one 10-12 mm trocar is satisfactory, but a second 10-12 mm in place of a 5 mm trocar may be considered because it allows for urgent insertion of a locking clip applicator or surgical sponge. Ligaments need only be transected if it will improve exposure. Preparation for a Pringle maneuver is rarely necessary for these resections, but is an important safety measure to be considered.

I prefer Harmonic shears for these resections (Ethicon Endo-Surgery, Inc., USA). The tapered active blade allows for dissection without significant parenchymal stretching or trauma. Dissection is further enhanced by vessels and ducts $\leq 2-3$ mm being coagulated on contact, so instrument activity does not require blade opposition. For coagulation of larger structures, exertion of pressure between blades for 3-5 s is required.

Resection margins are marked on the liver's surface using diathermy. The open jaws of a Harmonic Ace are 14 mm from edge-to-edge, and can be used as an *in vivo* measuring tape. Wide margins are not required for benign lesions, while a 10-mm margin is classically recommended for malignancies. The active blade of the Harmonic at a generator setting of 3 is used to penetrate, seal and transect the parenchyma. The jaw is slowly closed until the tissue gives way. The Harmonic is capable of sealing vessels ≤ 5 mm, and therefore any vascular or biliary structures encountered during the resections here proposed. Additional hemostasis is achieved with bipolar diathermy at generator settings of approximately 60 Watts. It may be useful to gently irrigate in order to keep the bipolar forceps from adhering to the eschar and disrupting hemostasis.

It is technically easier to resect a wedge of tissue with the base being the free edge of the liver than to core out a lesion. When a 360° coring out of a lesion is necessary, work circumferentially around the lesion with the Harmonic, progressively extending and measuring depth. Otherwise coning around the lesion and exposing the deep surface of the tumor is possible, or vascular and biliary structures can be inadvertently violated. Use of a suture is a helpful maneuver under these circumstances: a 4-0 suture is driven through the parenchyma without violating the gross tumor and used to lift the lesion away from the surrounding parenchyma to promote circumferential, consistent depth dissection. Tension should be just enough to move or elevate the lesion without tearing through the parenchyma, which will result in needless bleeding.

Regarding post-operative care, diets are advanced immediately and patients can be discharged home the same or next day as long as hemodynamics and hemoglobin are stable 2 and 6-8 hours after the procedure.

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