Chapter 12
Robotic Hepatectomy

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12.1 Introduction

Since the first laparoscopic liver resection was reported in 1991 [1], indications for laparoscopic hepatectomy have expanded to be nearly equivalent to that of open hepatectomy, with secondary metastases, and primary hepatic and biliary tract malignancies being the most common [2]. While lesion size and location remain important determinants of when laparoscopic hepatectomy is appropriate, minor resections such as laparoscopic left lateral sectionectomy have become standard of care [3, 4]. Long-term survival data are limited, however, recent studies demonstrate shorter operative time and length of stay, lower blood loss and transfusion rate, and decreased major morbidity, with similar overall complication rates for laparoscopic compared to open hepatectomy [4–6].

Robotic-assisted laparoscopic hepatectomy, or Robotic hepatectomy, is a newer approach to minimally invasive liver resection, with its use growing in parallel to the expanded application of robotic surgery across surgical subspecialties. Current literature comparing robotic to laparoscopic hepatectomy points to no significant differences in complication rates, length of stay, negative margin rate, reoperation, readmission, morbidity, or mortality, as well as overall survival or disease-free survival for oncologic resection, but arguably longer operating time and higher cost [6–8]. Potential benefits over conventional laparoscopic hepatectomy include decreased rate of conversion to open approach, better surgeon ergonomics, ability to perform higher complexity cases, and a shorter learning curve, presumably due to improved optical visualization and operative dexterity for suturing [9, 10]. With these technical advantages, recent studies have suggested its superiority to

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conventional laparoscopic resection of hepatic segments that are difficult to access laparoscopically, including segments 1, 4A, 7 and 8 [11, 12]. Our group's experience of over 250 robotic hepatectomy cases confirm these observations, however, additional prospective trials are needed to clarify many of these observations [13].

Herein we describe our institutional robotic approach to commonly performed hepatectomies. Note that while the following procedures are described based on the Intuitive Surgical Xi platform, the general principles are applicable to other robotic platforms.

12.1.1 Clinical Presentation and Preoperative Evaluation

Clinical presentation can be quite variable depending on the integrity of the liver parenchyma, and the location and size of the tumor(s) and effect on the vasculature or biliary tract. Subcapsular lesions can cause pain, biliary obstruction can result in jaundice, and venous invasion can lead to ascites. Treatment planning is heavily reliant on imaging. High-quality, contrast-enhanced, multi-phase, cross-sectional imaging with computed tomography (CT) or magnetic resonance (MR) imaging should be performed to outline the vascular anatomy along with any aberrancies, and to evaluate the tumor size, location and relationship with the surrounding vasculature prior to proceeding to the operating room.

Surgical resectability is assessed and defined based on the physiologic (patient protoplasm), oncologic (tumor biology), and technical (ability to obtain a negative margin while maintaining adequate liver remnant) considerations.

12.2 Technique and Steps of Operations

12.2.1 Patient Preparation and Positioning

The patient is brought to the operating room having received oral carbohydrate loading and subcutaneous heparin venous thromboembolism prophylaxis, and is placed supine on the operating table. The patient's core body temperature is maintained with an under-body warming pad and upper-body Baer hugger device, and a sequential-compression device is placed and activated. After completion of a safety timeout, the patient undergoes general anesthesia with endotracheal intubation. A Foley urinary catheter, large bore peripheral or central venous and radial arterial catheters are inserted as necessary, and prophylactic antibiotics are administered.

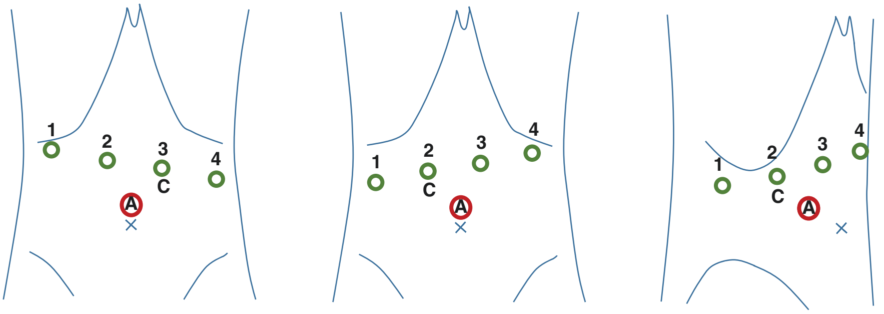
For most procedures, the patient is placed in split-leg, modified French position with both arms abducted, all pressure points padded, and secured at the chest, thighs and legs. For resection involving the posterior segments, the patient is placed in left lateral decubitus position. The patient is prepped and draped with the anatomic landmarks (xiphoid process, costal margins, and anterior superior iliac spine) exposed. After a second safety check list, access to the abdomen for routine cases is obtained through a 12 mm AirSeal™ port placed in the supraumbilical position via Hasson technique. The patient is placed in 20–30° reverse Trendelenberg and partial left or right lateral decubitus position as necessary. The peritoneal cavity is insufflated to 15 mmHg of CO_2 initially and inspected to rule out metastases.

Troubleshooting:

Prevention of subcutaneous emphysema—The 12 mm AirSeal port is secured to the skin with 0 polysorb suture to prevent migration of the insufflation outlets into the subcutaneous tissue.

12.2.2 Port and Instrument Placement

After anesthetizing the skin and peritoneum, four robotic ports are sequentially placed, the first being the camera port to confirm optimal visualization. The camera is placed in arm #3 for left-sided hepatectomies (LSH) and arm #2 for right-sided hepatectomies (RSH) with the port 10–15 cm from the target anatomy. The robotic patient cart is deployed for an upper abdominal case and docked on the patient's left or right side. The bedside assistant stands between the patient's legs, with the scrub nurse opposite the patient cart. The bedside assistant uses the 12 mm AirSeal port, and an additional 5 mm port if necessary. The Tip-Up fenestrated grasper for retraction is placed in arm #4 (LSH) or #1 (RSH). The energy device [monopolar curved shears (MCS)/harmonic scalpel (HS)]and needle driver are placed in arms #2 (LSH) or #3 (RSH), and the Cadiere forceps in arm #1 (LSH) or #4 (RSH) (Figs. 12.1 and 12.2).



1a. left-sided hepatectomy 1b. right-sided hepatectomy 1c. posterior sectionectomy

Fig. 12.1 Port placement. (**1a**, **1b**) #1: R anterior axillary, #2: R parasternal, #3: L parasternal, #4: L anterior axillary. (**1c**) #1:R mid-axillary, #2: R anterior axillary, #3: R parasternal, #4: L parasternal. A: Assistant port

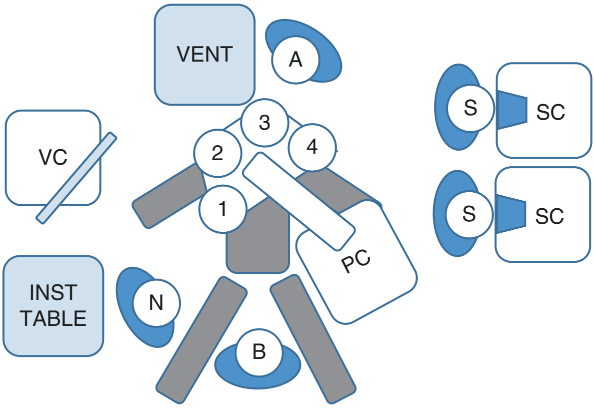


Fig. 12.2 OR set-up and robot docking from patient's left side. A: anesthesia, B: bedside assistant, N: scrub nurse, S: surgeon, PC: patient cart, #1–4: robotic arms, SC: surgeon console, VC: vision cart, VENT: ventilator, INST TABLE: instrument table

Troubleshooting:

Optimal port placement—It is important to ensure that the most superior and posterior aspects of the parenchymal transection are adequately visualized and can be reached by the instruments, especially when using the HS which is the shortest robotic instrument, and for lesions located in the superior segments, i.e. S2, S4A, S7, S8.

Adhesions—Significant adhesions from prior abdominal surgery may be encountered on initial diagnostic laparoscopy. Additional ports should be placed (ideally using planned robotic port sites) and laparoscopic shears with electrocautery can be used for adhesiolysis to allow for sequential port placement. Further lysis of adhesions is performed robotically following docking, however, extensive adhesions may warrant conversion to an open approach.

Challenging body habitus—Patients with low and/or narrow costal margins, and those with obese abdominal girth may present unique challenges to achieving optimal access to and exposure of the target anatomy due to lack of adequate space for optimal port placement or due to poor insufflation. Careful assessment of accessibility via laparoscopy prior to placement of the robotic ports is advised as the likelihood of conversion is relatively high given the steeper instrument angles and/or insufficient space for optimal port placement or visualization.

12.2.3 Liver Mobilization

The ligamentum teres hepatis is divided using MCS close to the abdominal wall to prevent visual obstruction by its remnant, and used to retract the liver to facilitate parenchymal transection. The falciform ligament is divided with MCS to the hepatic venous confluence, and the left or right coronary and triangular ligaments are divided with MCS to fully mobilize the left or the right liver lobe, respectively. For the left side, this is best initiated from above the liver by retracting the left lateral

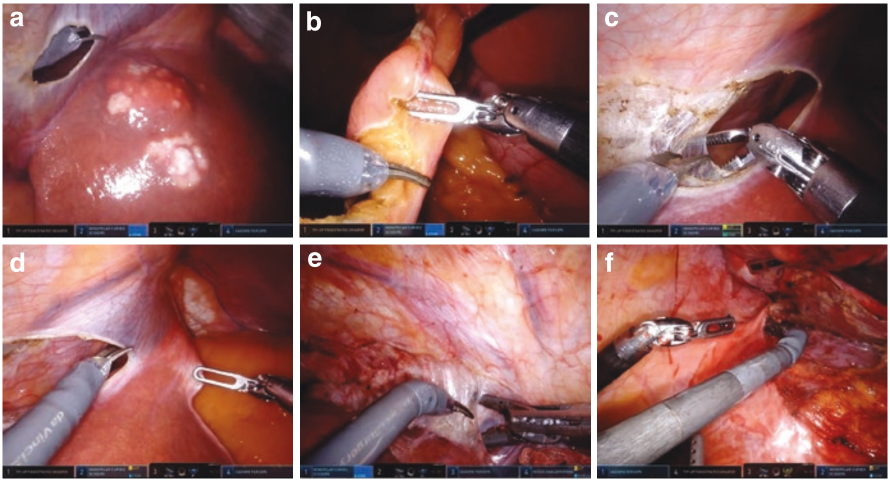


Fig. 12.3 Mobilization of the liver. Division of (**a**) falciform ligament, (**b**) ligamentum teres hepatis. Division of (**c**) left coronary, (**d**) left triangular ligaments to mobilize the left liver lobe. Right triangular ligament divided from (**e**) above and (**f**) from below to mobilize right lobe

sector inferiorly and anteriorly, and finding a transparent region in the mid-portion of the coronary ligament which is divided, taking care not to injure the esophagus. The triangular ligament is then divided laterally. The liver is then lifted superiorly and anteriorly, and the remaining coronary ligament is divided toward the IVC taking care to avoid injury to the left inferior phrenic vein. For the right side, the coronary ligament is divided from above the liver, taking care not to injure the right hepatic vein. The majority of the mobilization is performed from inferiorly by retracting the liver anteriorly and dividing the triangular ligament with MCS toward the IVC. Attention should pay to avoid injury to the adrenal gland and its drainage into the IVC (Fig. 12.3).

Troubleshooting:

Friable liver parenchyma—For patients with significant steatosis, the liver parenchyma can be quite friable and may lead to fracturing during retraction. A vaginal pack can be used to pad the Tip-Up grasper to aid in the retraction to mitigate this problem when encountered.

12.2.4 Ultrasound Examination

Ultrasonography is routinely performed to outline the vascular anatomy and flow, to rule out unexpected lesions, to delineate the relationship between the tumor(s) and the surrounding vasculature and bile ducts, and to plan the transection plane. The robotic drop-in ultrasound probe is introduced through the 12 mm assistant port and

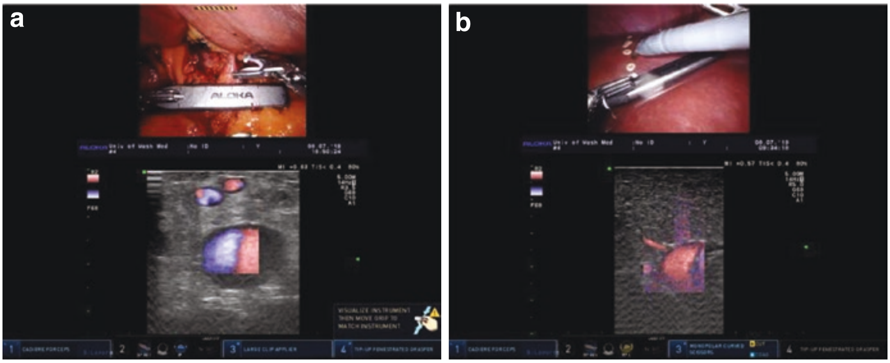


Fig. 12.4 Ultrasound images visualized on TilePro display. (**a**) Confirmation of the hilar structures by ultrasound. (**b**) Ultrasound guided marking of surgical margin

controlled using the Cadiere forceps, with the sonographic images broadcast through the TilePro display on the surgeon console and the laparoscopic monitors for real-time visualization (Fig. 12.4).

12.2.5 Indocyanine Green Fluorescence

Indocyanine green (ICG) can be used to aid in tumor identification, accurate delineation of the surgical margin, and preservation of the liver remnant. To identify the tumor, ICG (7.5 mg) is injected intravenously 48 h prior to surgery. Margin and remnant assessment can be evaluated by occluding the portal pedicles of interest and administering ICG (2.5 mg) intravenously. Fluorescence within the vascularized liver parenchyma is visualized within 10–15 minutes using the Firefly™ fluorescence imaging system. ICG fluorescence can also be used to identify bile leaks (Fig. 12.5).

12.2.6 Parenchymal Transection

The transection plane is based on preoperative cross-sectional imaging, intraoperative ultrasound examination and if necessary ICG fluorescence. The transection line is marked on the liver capsule with the MCS under ultrasound guidance. Prior to parenchymal transection, the abdominal insufflation pressure is lowered to 7–12 mmHg to minimize risk of CO_2 embolism. The parenchyma is divided using the HS. Cavitron ultrasonic surgical aspirator (CUSA™) can also be used to divide the parenchyma. Small portal pedicles and hepatic venules can be controlled effectively using the HS or small titanium clips. Larger portal pedicles and hepatic veins are defined using clamp-crush tissue fracture technique with the HS, encircled using

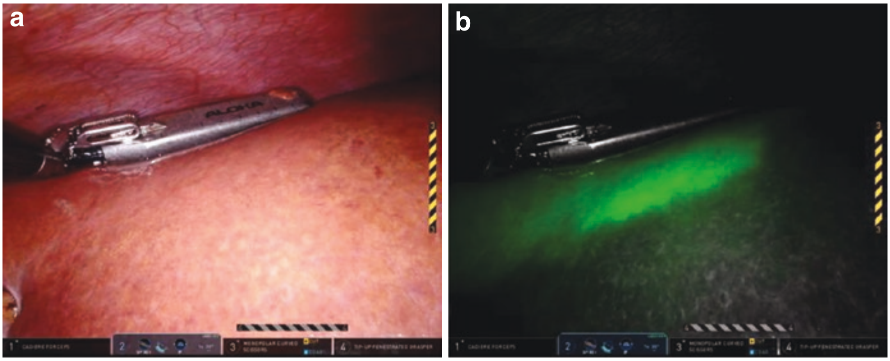


Fig. 12.5 Viable liver parenchyma highlighted with ICG fluorescence. (**a**) Parenchymal demarcation following division of portal pedicle is visually non-apparent. (**b**) Vascularized parenchyma is clearly visualized using ICG FireFly fluorescence imaging

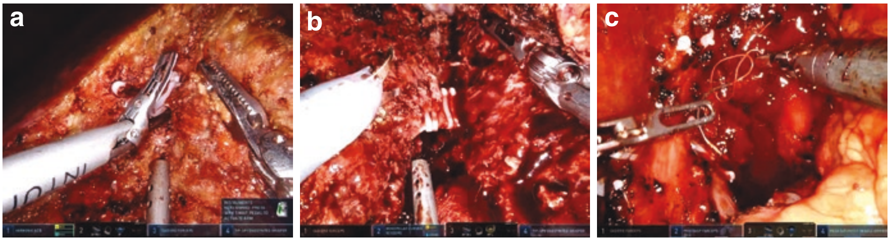


Fig. 12.6 Parenchymal transection. (**a**) Harmonic scalpel division of parenchyma and small left portal pedicle. (**b**) Division of main right hepatic vein with Hem-o-lok clips and MCS. (**c**) Suture control of branches to IVC following caudate lobe resection

MCS, then divided between Hem-o-lok™ clips, with suture reinforcement if necessary. The main portal vein and main hepatic veins are secured and divided using the EndoGIA or robotic stapler with vascular load (2–2.5 mm staple height) if too large for Hem-o-lok clips. 4–0 prolene or 3–0 polysorb sutures are used to control bleeding by direct repair of venotomies or by *en mass* closure, respectively. Hemostatic agents such as Surgicel and Fibrillar are applied if necessary (Fig. 12.6).

Troubleshooting:

Obtaining the optimal transection angle with the HS—Given that the HS does not have the ability to articulate or roticulate, it can be challenging to achieve the optimal angles for parenchymal division. The liver parenchyma can be gently manipulated via retraction to achieve the necessary angle for the HS.

Carbon dioxide (CO_2) embolism—Clinically significant CO_2 embolism is a rare but potentially fatal complication, with reported mortality as high as 28%. It occurs when CO_2 enters a hepatic venotomy and causes a sudden rise then precipitous drop in end-tidal CO_2 accompanied by oxygen desaturation, hypotension, arrhythmia, and ultimately cardiac collapse as a result of embolic right ventricular occlusion and reduction of pulmonary blood flow. The most sensitive test for detection is transesophageal echocardiogram. Treatment entails immediate desufflation of the abdomen, placement of the patient in Durant's position (left lateral decubitus and steep Trendelenburg) to prevent gas passage into the pulmonary artery, 100% O_2 ventilation to improve hypoxemia and ventilation-perfusion mismatch, hyperventilation to eliminate CO_2, attempted aspiration of CO_2 through a central line, and cardiopulmonary resuscitation if necessary. Significant CO_2 embolism can be avoided by end-tidal CO_2 monitoring, lower insufflation pressures during division of the liver parenchyma, and prompt repair of venotomies.

12.2.7 Inspection and Specimen Retrieval

The surgical bed is irrigated, and hemostasis is confirmed. A vaginal pack is used to check for bile leak. Ultrasound is performed to confirm preservation of vascular inflow and outflow of the remnant. The resected specimen is removed in an EndoCatch™ bag delivered through an extension of the assistant port site, or separate Pfannenstiel incision. The robot is undocked after gross margin assessment in Pathology, and following a period of desufflation to ensure complete hemostasis. After instrument, needle, and sponge counts are confirmed, all incisions are closed in layers (Fig. 12.7).

Troubleshooting:

Large tumor extraction—Especially following major hepatectomy, the specimen may be too large to place in the EndoCatch bag efficiently. The extraction incision can be made first and the specimen extraction can be assisted using the hand.

12.2.8 Left Lateral Sectionectomy

The patient is placed in supine, modified French position and the ports are placed as depicted in Fig. 12.1a. The ligamentum teres hepatis, falciform ligament, left coronary and triangular ligaments are divided with MCS to fully mobilize the left lateral

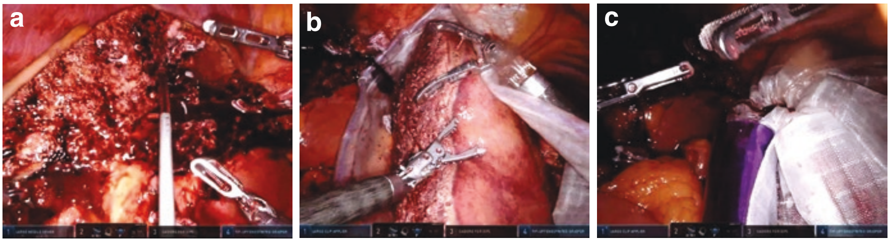


Fig. 12.7 Inspection and specimen retrieval. (**a**) Irrigation of surgical bed. (**b**, **c**) Placement of specimen in EndoCatch bag and closure

section. The parenchymal bridge between S3 and S4B if present, is divided using MCS or HS.

The transection line lateral to the falciform ligament is scored with MCS under ultrasound guidance, making note of the tumor and its relationship to the left main portal pedicle and take off of the S2/S3 portal pedicles and the left hepatic vein.

The liver parenchyma is divided using the HS, in a caudal-to-cranial and anterior-to-posterior trajectory. Small portal pedicles and hepatic venules are controlled using the HS or small titanium clips. The S3 followed by S2 portal pedicles are defined by clamp-crush tissue fracture technique using the HS or Cadiere grasper, and encircled using MCS, then sequentially divided between Hem-o-lok clips, with suture reinforcement if necessary.

The parenchymal transection is continued cephalad and posteriorly, and branches of the left hepatic vein are dissected with the HS and divided between Hem-o-lok clips. The main left hepatic vein is controlled with 4–0 prolene suture and Hem-o-lok clips, or EndoGIA or robotic stapler with vascular load if the vein is large. Hemostasis, inspection and specimen retrieval is performed as described above.

Troubleshooting:

Medial tumors—For tumors located more medially in the left lateral section, care must be taken to avoid damage to the left main portal pedicle and preserve inflow to segments 4A/B by ultrasound (Fig. 12.8).

12.2.9 Left Hepatectomy

The patient is placed supine, modified French position and ports are placed as depicted in Fig. 12.1a. The ligamentum teres hepatis, falciform ligament, left coronary and triangular ligaments are divided using MCS to fully mobilize the left liver lobe as described in the mobilization section.

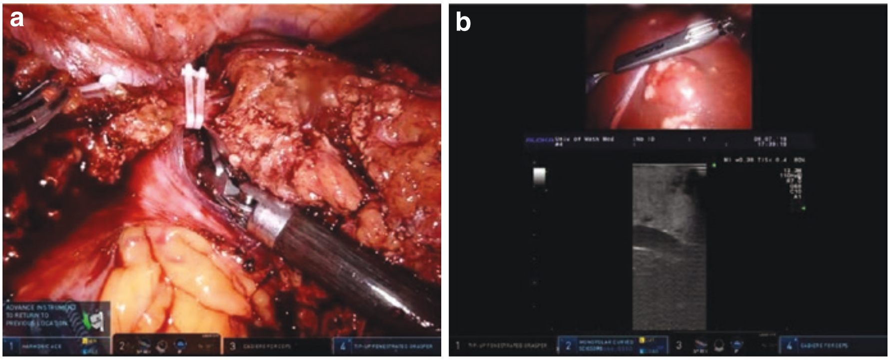


Fig. 12.8 Left lateral sectionectomy. (**a**) Main left hepatic vein divided using Hem-o-lok clips. (**b**) Medial tumor in close proximity to main left portal pedicle

The liver is retracted cephalad and anteriorly using the Tip-Up grasper. Cholecystectomy is performed if the gallbladder is present. The gastrohepatic ligament is divided using MCS to expose the hepatic artery, and if an accessory left hepatic artery is present, it is divided between Hem-o-lok clips. The porta hepatis is exposed by dividing lymphatics and opening Glisson's sheath with MCS. The hepatic arterial and portal venous course is visually identified and ultrasound is used to confirm the anatomy. With robust inflow to the right liver confirmed, the left hepatic artery and portal vein are encircled and divided between Hem-o-lok clips. An EndoGIA or robotic stapler with vascular load can be used for a large portal vein. The left bile duct is identified, encircled, and divided between Hem-o-lok clips.

After inflow is controlled, indocyanine green can be injected intravenously to enhance the parenchymal transection line. Under ultrasound guidance, the transection line preserving the middle hepatic vein is scored with MCS, making note of the tumor and its relationship to the portal bifurcation and the middle hepatic vein.

The insufflation pressure is lowered to 7–12 mmHg to minimize the risk of CO_2 embolism. The liver parenchyma is divided in layers, caudal-to-cranial, using the HS. Small portal pedicles and hepatic venules are controlled using the HS or small titanium clips. Larger branches of the middle hepatic vein and peripheral S4A/B portal pedicles identified by ultrasound are defined by tissue fracture technique using the HSor Cadiere grasper, and encircled using MCS, then sequentially divided between Hem-o-lok clips, with suture reinforcement if necessary.

The parenchymal transection is continued cephalad and posteriorly, and branches of the left and middle hepatic vein are dissected with the HS and divided between Hem-o-lok clips. The main left hepatic vein is controlled with 4–0 prolene suture and Hem-o-lok clips, or EndoGIA or robotic stapler with vascular load if the vein is large. Hemostasis, inspection and specimen retrieval is performed as described above.

Troubleshooting:

Preservation of the caudate lobe – Care is required not to injure the inflow to the left-side of the caudate lobe if goal is to preserve. The portal pedicle should be divided distal to the caudate branch (Fig. 12.9).

Fig. 12.9 Left hepatectomy. (**a**) Identification of the left portal vein. (**b**) Division of the left portal vein distal to the caudate branch take-off. (**c**) Preserved caudate lobe

12.2.10 Right Hepatectomy

The patient is placed in supine, modified French position and the ports are placed as depicted in Fig. 12.1b. The ligamentum teres hepatis, falciform ligament, right coronary and triangular ligaments are divided using MCS to fully mobilize the right liver as described in the mobilization section.

The liver is retracted cephalad and anteriorly using the Tip-Up grasper. Cholecystectomy is performed if the gallbladder is present. The porta hepatis is exposed by dividing lymphatics and opening Glisson's sheath with MCS. The hepatic arterial and portal venous course is visually identified and ultrasound is used to confirm the anatomy. With robust inflow to the left liver confirmed, the right hepatic artery and portal vein are encircled and divided between Hem-o-lok clips. An EndoGIA or robotic stapler with vascular load can be used for a large portal vein. The right bile duct is identified, encircled, and divided between clips.

After inflow is controlled, indocyanine green can be injected intravenously to enhance the parenchymal transection line. Under ultrasound guidance, the transection line preserving the middle hepatic vein is scored with MCS, making note of the tumor and its relationship to the portal bifurcation and the middle hepatic vein.

The insufflation pressure is lowered to 7–12 mmHg to minimize the risk of CO_2 embolism. The liver parenchyma is divided in layers, caudal-to-cranial, using the HS. Small portal pedicles and hepatic venules are controlled using the HS or small titanium clips. Larger branches of the middle hepatic vein and peripheral S5/S8 portal pedicles identified by ultrasound are defined by tissue fracture technique using the HS or Cadiere grasper, and encircled using MCS, then sequentially divided between Hem-o-lok clips, with suture reinforcement if necessary.

The parenchymal transection is continued cephalad and posteriorly, and branches of the middle and right hepatic vein are dissected with the HS and divided between Hem-o-lok clips. The main and accessory right hepatic veins are controlled with 4–0 prolene suture and Hem-o-lok clips, or EndoGIA or robotic stapler with vascular load if the vein is large. Hemostasis, inspection and specimen retrieval is performed as described above.

Troubleshooting:

Poor access to the inflow—When the right portal pedicles cannot be controlled extrahepatically, the liver parenchyma can be divided to expose these structures (Fig. 12.10).

12.2.11 Posterior Sectionectomy

The patient is placed in left lateral decubitus position and ports are placed as depicted in Fig. 12.1c. The ligamentum teres hepatis, falciform ligament, right coronary and triangular ligaments are divided using MCS to fully mobilize the right liver lobe as described in the mobilization section.

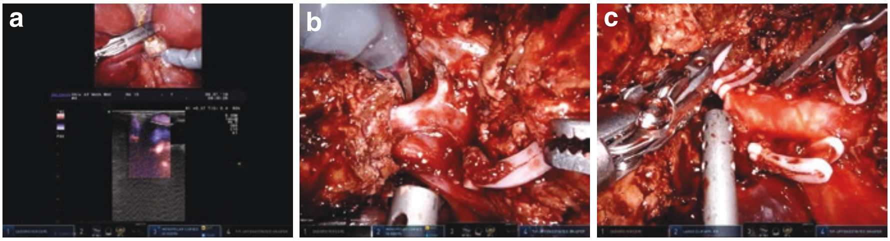


Fig. 12.10 Right hepatectomy. (**a**) Ultrasound visualization of intrahepatic right portal structures. (**b**) Isolation of anterior and posterior sectoral portal pedicles. (**c**) Division of the portal pedicles between Hem-o-lok clips

The liver is retracted cephalad and anteriorly using the Tip-Up grasper. The posterior portal pedicle can be accessed either through the fissure of Gans (Rouviere's sulcus) or following parenchymal transection. The hepatic arterial and portal venous course is visually identified and ultrasound is used to confirm the anatomy. With robust inflow to the anterior sectoral portal pedicle confirmed, the posterior portal pedicle is encircled and divided between Hem-o-lok clips. An EndoGIA or robotic stapler with vascular load can be used for a large portal vein.

After inflow is controlled, indocyanine green can be injected intravenously to identify the parenchymal transection line. Under ultrasound guidance, the transection line is scored with MCS, making note of the tumor and its relationship to the portal bifurcation and the right hepatic vein.

The insufflation pressure is lowered to 7–12 mmHg to minimize the risk of CO_2 embolism. The liver parenchyma is divided in layers, caudal-to-cranial, using theHS. Small portal pedicles and hepatic venules are controlled using the HS or small titanium clips. Larger branches of the right hepatic vein and peripheral S6/S7 portal pedicles identified by ultrasound, are defined by tissue fracture technique using the HS or Cadiere grasper, and encircled using MCS, then sequentially divided between Hem-o-lok clips, with suture reinforcement if necessary.

The parenchymal transection is continued cephalad and posteriorly, and branches of the right hepatic vein are dissected with the HS and divided between Hem-o-lok clips. The main and accessory right hepatic veins are controlled with 4–0 prolene suture and Hem-o-lok clips, or EndoGIA or robotic stapler with vascular load if the vein is large. Hemostasis, inspection and specimen retrieval is performed as described above.

12.2.12 Parenchymal Sparing Resection

Port placement and patient positioning dependent on location of the segment(s) being resected. Any segment(s) of the liver can be resected in isolation. The position and angle of the energy device is optimized for the segment of interest. The concepts for mobilization, parenchymal transection, hemostasis, and specimen retrieval are identical to the resection types described above.

12.2.13 Real-Time Navigation

The DICOM images from the patient's CT or MR imaging can be used to produce interactive three dimensional PDFs that can then be overlaid directly onto the surgeon console view. These PDF overlays can demonstrate the tumor's location in relation to the vascular and biliary structures in real-time. This technology can enhance the surgeon's ability to visualize the anatomy and perform a margin negative resection.

Video and images courtesy of Intuitive Surgical, Inc.. The da Vinci technology presented is still in development, is not 510(k) cleared and the safety and effectiveness of the product has not been established. The technology is not currently for sale in the US (Fig. 12.11).

12.2.14 Conversion to Open Surgery

Conversion from robotic hepatectomy to open hepatectomy has been reported to occur 0–55% of cases. In our series, we observed a conversion rate of 4.6% [13]. The most common reasons for conversion include challenging anatomy, prohibitive adhesions, hemorrhage control, and failure to progress. Conversion should not be viewed as failure, but should be performed promptly and without hesitation when indicated. Prior to conversion, a quick time-out should be performed to assign tasks and review a plan of action. It is critical to maintain calm, use direct, clear, and closed-loop communication with the nursing and anesthesia teams to ensure efficient conversion and adequate resuscitation during a potentially life-threatening scenario.

Troubleshooting:

Encountering massive hemorrhage—If rapid conversion is necessitated for hemorrhage that cannot be controlled robotically, the assistant should apply pressure to

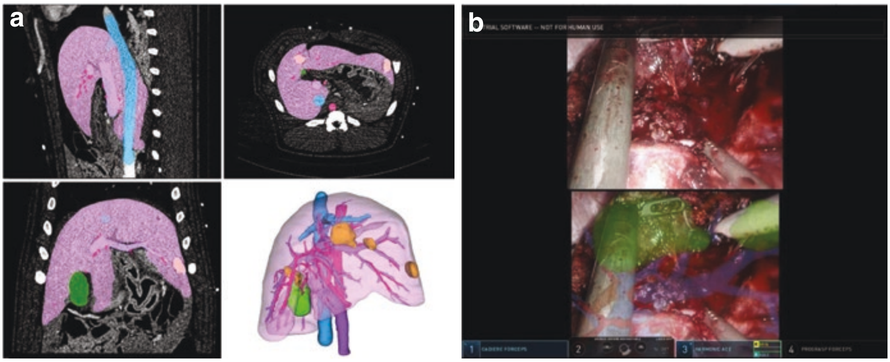


Fig. 12.11 Real-time navigation. (**a**) Interactive 3D PDFs generated from CT/MR DICOMs. (**b**) Real-time overlay of PDF onto console TilePro

the area with a vaginal pack to facilitate tamponade and temporarily minimize blood loss. A robotic instrument not in line with the planned incision, e.g. arm #4 can be used to assist in maintenance of pressure over the area of hemorrhage until the incision is made. Once open control of the hemorrhage has been obtained, the robot is undocked and removed.

12.2.15 Postoperative Course

Unless there was significant intra-operative hemorrhage, the patient is extubated in the OR, monitored for 1–2 h in the post-anesthesia care unit, and admitted to the acute care floor for recovery. Clear liquid diet is started postoperatively and advanced as tolerated on postoperative day 1. Based on our early recovery after surgery (ERAS) protocol, the patient is monitored with q1 hour x2, q2 hour x2, then q4 hour vitals with I + O's, and q8 hour hematocrit and INR measurements in the first 24 h. Daily comprehensive metabolic panel and complete blood counts are continued. The Foley catheter is removed on postoperative day 1 or 2, prophylactic subcutaneous heparin administration, aggressive ambulation and incentive spirometry is started on day 1. Hospital stay is typically 1–2 days for minor and 2–3 days for major hepatectomies.

12.3 Conclusions

Robotic hepatectomy can be performed safely with similar outcomes to laparoscopic hepatectomy with regard to length of stay, rate of complication and readmission. The steps of the operation are essentially unchanged from the conventional laparoscopic approach. The lower rate of conversion to open (compared to laparoscopy), presumably due to better visualization and hemostasis, may offset the increased costs of resources associated with the robotic approach. As experience with the robotic platform increases, the flatter learning curve for robotic hepatectomy is expected to continue to flatten further.

Conflict of Interest The authors have no conflict of interest to declare.

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